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OCTOBER 1961

World Oil

EXPLORATION • DRILLING • PRODUCTION

Aftermath of a storm . . . Gulf Coast operators look at the damage caused by Hurricane Carla . . . and the lessons learned in her violent wake

PAGE 16

DRILLING PROGRESS 1961

Still beset by a host of problems, the drilling industry looks to new techniques and practices as one avenue toward regaining a healthy status

PAGE 115

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"He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine receives light without darkening me."
—Thomas Jefferson.

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QUICK LOOK at this issue

To help you put first things first, scan these time-saving digests, checking those you want to read first.

☐ **Middle East seeks bigger role in oil company operations . . .** The oil and gas picture is changing fast in the Middle East. Plans to prorate crude production, export natural gas and obtain a larger share of international oil company operations are examples.

To get a clear picture of the new developments, and the motives behind them, WORLD OIL Drilling Editor Jack Earl, through the cooperation of independent industrialist Harry T. McClain, traveled more than 30,000 miles to obtain an exclusive interview with Saudi Arabia's Minister of Petroleum and Mineral Resources Abdullah H. Tariki at Riyadh, Saudi Arabia.

For a candid view of current international oil problems as seen through the eyes of a prominent Middle East leader, turn to ..... **Page 12**

☐ **What operators learned from Carla . . .** Hurricane Carla's multi-million dollar blow to Gulf Coast drilling and production facilities was the most destructive in the history of the industry. Many valuable lessons were learned in her violent wake. To get the complete story from the operator's viewpoint, the WORLD OIL staff visited the scenes of damage to obtain the exclusive picture story, damage reports and tips on how to reduce future losses that you will find, starting on ..... **Page 16**

☐ **Reduced substructure increases rig mobility . . .** Delta Drilling Company introduced many valuable new concepts when it redesigned standard derrick rig 4. The standard derrick has been replaced by a

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jackknife derrick, engines and drawworks are on the same level only 5 feet off the ground and 11 feet below the derrick floor. The rig can be skidded from one location to another in one complete unit. Installation of engine and drawworks do not require high, steep ramps. For a detailed description of the new rig, plus a pictorial report on the moving and rigging up operation, turn to **Page 116**

☐ **How to predict diamond bit drilling costs . . .** Predicting and comparing diamond bit performance with rock bits in comparable formations are simplified with an easy-to-use method which utilizes total hole cost. Effects of drilling rate, trip time and net bit cost are included. For a step-by-step explanation of the method, including examples of typical calculations, turn to **Page 122**

☐ **Engineered hydraulic programs reduce California drilling costs . . .** Application of an efficiently designed hydraulic program to each job has increased penetration rates and cut drilling costs in numerous California fields. Savings up to 15 percent have been recorded. For a practical dollars-and-cents discussion of ways to apply these ideas to your operations, turn to . . . . . **Page 126**

☐ **New wellhead saves rig time . . .** Gulf Oil Corporation recently introduced a new wellhead assembly that is reducing rig time in various fields along the Louisiana coast. Blowout preventers are installed on the conductor pipe and are not removed until the tree is installed just prior to bringing in the well. See **Page 132,** for a step-by-step description of the operational procedures used to set up this new assembly.

☐ **Facies changes are key to Marietta Basin's oil future . . .** The Marietta Basin, straddling the Red River along the Texas-Oklahoma boundary is attracting exploratory and deep drilling interest out of proportion to its size. The Basin is considered a crossroads of U.S. Mid-Continent deep drilling and sedimentary geology, ringed as it is by better-known geological provinces which are all reflected to some extent by formations found in the Marietta Basin trough. Multi-pay Pennsylvanian, Hunton, Simpson and Arbuckle strata are prospective . . . . . **Page 137**

☐ **New type dual completion cuts costs, boosts recovery . . .** Sun Oil Company has developed a unique new wireline retrieveable multiple completion tool which permits production from separate reservoirs to be commingled downhole and produced through a single tubing string. A simple wireline operation is all that is required to determine the contribution from each zone . . . . . **See Page 144**

☐ **Regional magnetic data show prospective trends . . .** The aerial magnetic method of regional oil and gas exploration provides very rapid reconnaissance coverage of new areas. The Spanish Sahara is a good recent example of such fast coverage of a previously little-known area. Likely oil-prospective trends of an entire country may be inferred from a bare minimum of low-cost regional magnetic data, exemplified in this article (Part 2 of a series of five) by an isogon map of Venezuela superimposed on sedimentary basins and producing trends . . . . . **Page 148**

☐ **New completion will cut deep, multiple well workover costs . . .** Southern Natural Gas Company has completed the industry's first deep dual well equipped with twin strings of 4½-inch OD casing. The

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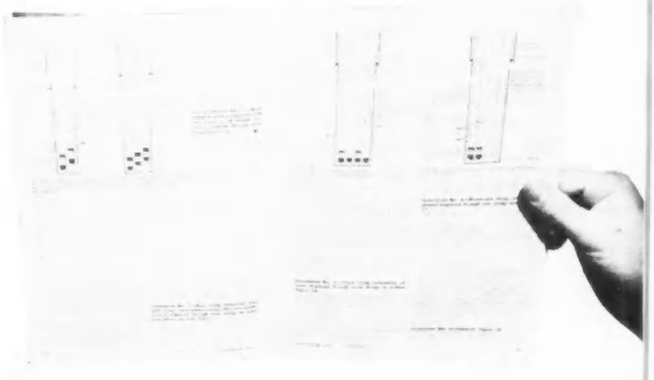

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12,400-foot South Louisiana completion was especially designed to eliminate communication between zones caused by packer failure or blast holes in tubing strings set through upper producing intervals. For a detailed report on this unique installation. See.....Page 150

☐ **Small diameter well completions (Part 3) . . .** Good primary cement jobs have been difficult to obtain on small diameter wells, particularly on multiple string completions. This section of Engineering Practices Manual No. 4 explains how operators have modified casing running and cementing practices to minimize the problem. See.....Page 155

☐ **Kingfisher County—hottest oil play in U.S. . . .** For the past three years a new well has spud in every three days in Kingfisher County, Oklahoma, where some 40 rigs are developing an area which, less than four years ago was considered a washout. More than 500 tests have been drilled resulting in more than 450 producers. This high success ratio results from big pools occurring in large traps. For complete details, plus informative maps illustrating the phenomenal growth of this promising area, turn to.....Page 173

☐ **How oil firms handle conflicts of interest . . .** The Chrysler incident of last summer and the convictions in the heavy electrical equipment industry last winter adversely affected every big corporation in the country. The first, involving employes' conflicts of interest, sparked immediate action to put previously unwritten policies into written form. For the first published report on the new trend, factors to consider in preparing a written policy, plus a sample policy prepared for Continental Oil Company after surveying 79 other corporations, turn to.....Page 178

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Donald E. Kliewer

Editorial Director

Oil Industry In Brief

Demand sluggish. Domestic production and imports averaged 3-4 percent above last year during first eight months of '61, while petroleum demand increased only ½ of 1 percent. See Page 27.

Supply continues excessive. Stocks of all oils totaled 844 million barrels at August's end, up 42 million barrels or 5.2 percent over same '60 date. Crude oil stocks of 249.2 million barrels were up 15.1 million barrels or 6.5 percent. See Page 27.

World demand to shoot upward. At current rates, world demand for petroleum will jump 40 percent to 29 million barrels daily by 1965, about equal to today's producing capacity. Also, competition for markets between oil and gas on a world-wide basis will get underway. See Page 11.

No need for new gas legislation? FPC Chairman Joseph Swidler doesn't think so. He says such legislation might simply add to confusion and uncertainty that already exists. If FPC attorneys give green light, he intends to regulate in-place sales of natural gas—decontrol small gas producers, "if the idea makes sense." See Page 25.

Domestic producers' earnings don't measure up. IPAA survey shows that of 36 primarily domestic producing companies, 13 (or 36.1 percent) had lower earnings during first half of '61 than they had in same '60 period. Total earnings were up 8.5 percent for the 36 companies, compared with increases of 13.8 percent for 12 integrated-historic importing companies, and 11.8 percent for 18 other integrated companies.

Oil and gas value increases. Oil and gas accounted for more than half total value of all mineral production in the U.S. during 1960. Total value at wellhead was $9.9 billion, compared with $9.6 billion in 1959. About 422 million acres, or 19 percent of total U.S. land area is either productive or under lease.

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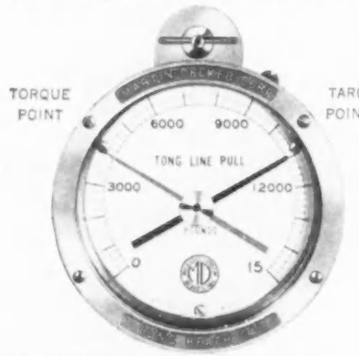

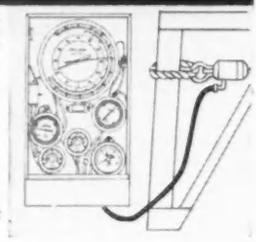

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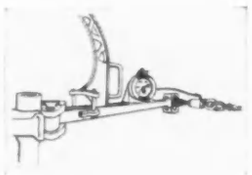

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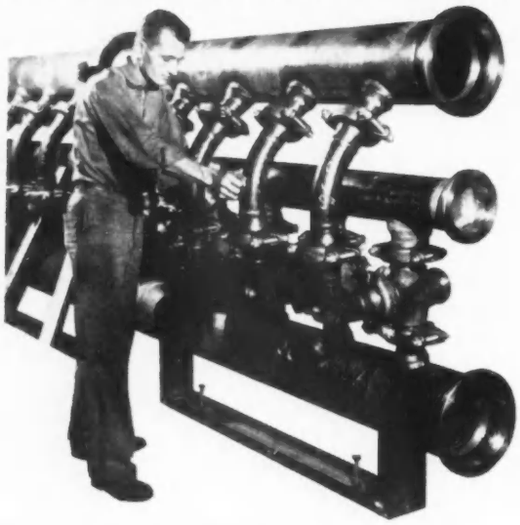

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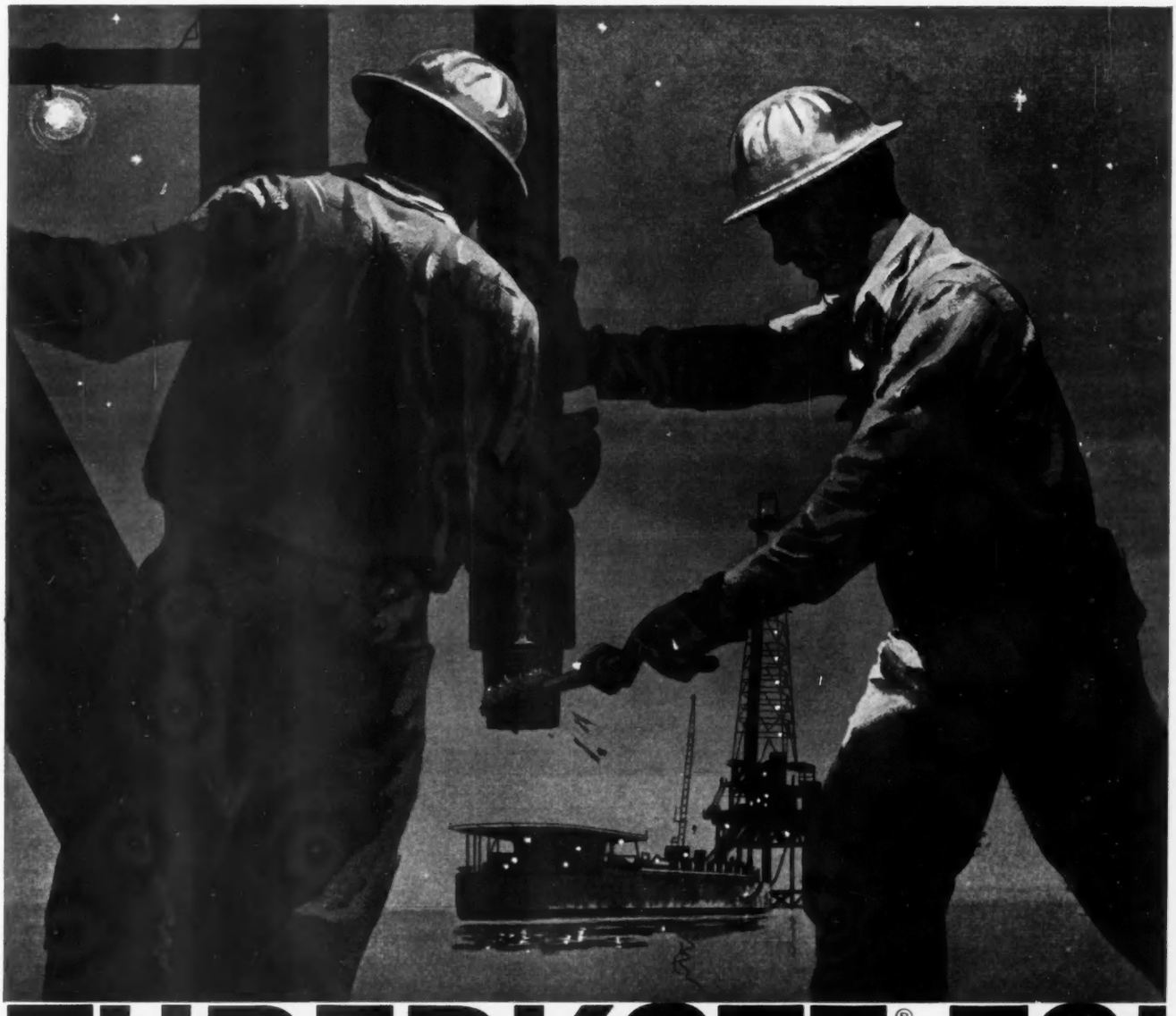

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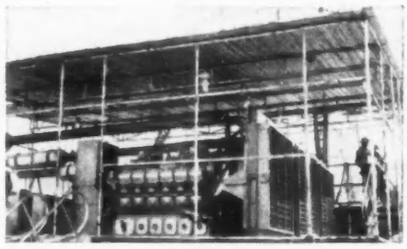
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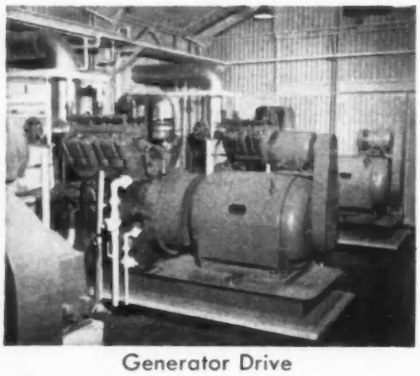
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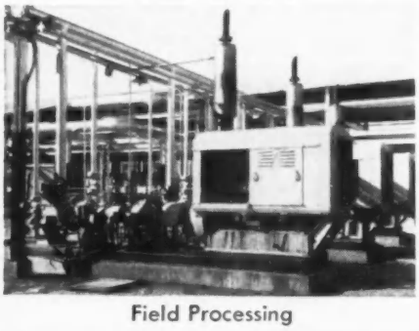
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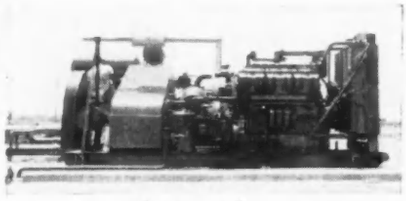
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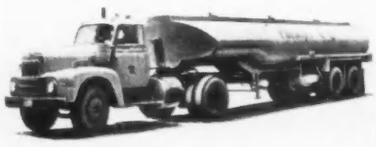
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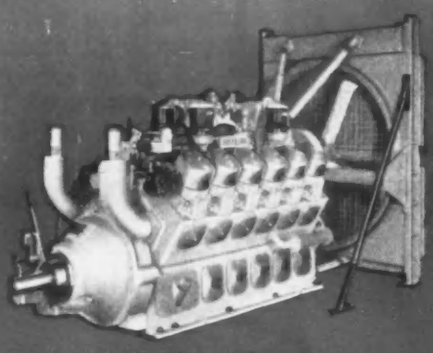
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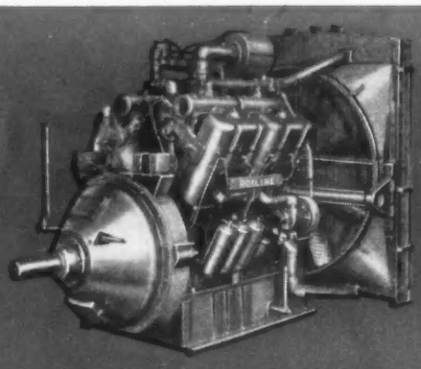
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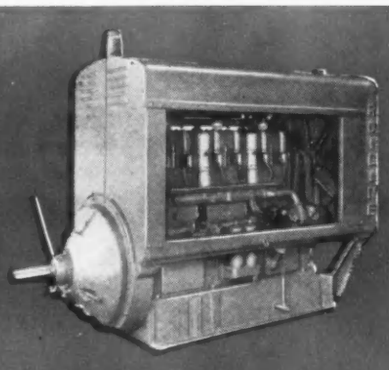
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Looking Ahead

Drilling with casing to be field tested in California . . . Casing controlled drilling, a new technique combining the time-proven advantages of closed circuit air drilling, fast penetration inherent in hammer drilling, plus the advantages of carrying the casing (or liner) string just above the bit, will be field tested shortly.

Designed especially for drilling-in and setting pipe opposite permeable or low pressure producing zones, the method is expected to result in better completions. Improvements are expected to include reduced hole cavitation, minimum particle penetration—also less rig time, less air and fewer bits.

Critical years ahead for world oil supply-demand . . . Look for these factors to come to a head in 1965:

- World petroleum demand should reach 29 million barrels per day (up 40 percent over 1961), about equal to today's world crude producing capacity. Less shut-in capacity should exist.
- International methane shipments on a commercial basis should begin in 1964 or 1965. Time between contract signing and actual delivery will be about 30 months, allowing for specialized tanker, liquefaction plant, and terminals construction. Competition for markets between natural gas and oil will commence on world-wide basis.
- Russia's large-diameter pipe lines to provide 1 million barrels of crude oil per day export capacity probably will be fully operative by 1965.

Connally Act changes proposed . . . Interior Secretary Udall suggests modifications of reporting requirements of the Connally "hot oil" Act. Included are some changes proposed by the industry to allow use of modern data processing methods in making reports. Announcement was made September 15. Proposed rules are to be published in Federal Register. A 30-day invitation period for comments and suggestions, to be addressed to the Director, U.S. Geological Survey, Washington 25, D.C., will follow.

Private companies do more oil bartering . . . A Middle East producer-refiner directly swapped some fuel oil to a Japanese manufacturer for new tanks needed for field crude oil storage. Much publicity has been given to barter deals made by Russia, Brazil, Italy, etc—but little has been said about bartering by private oil firms, something that has been going on for years.

As a Shell group official put it, "We may take fish from Iceland or eggs from Turkey, but we usually get our money one way or the other."

Watch tax angles on leased equipment . . . Equipment leased for oil operations allows virtually 100 percent equipment financing. Freed capital can be used for extended drilling programs, and additional funds can be had from sale and leaseback of production or plant facilities.

But—if a lease payment is to be tax-deductible, the taxpayer must not (1) have taken title to equipment; (2) be taking title by a conditional sales contract or otherwise; nor (3) have on equity in the equipment.

a WORLD OIL interview with
Abdullah H. Tariki, Minister of Petroleum,
Riyadh, Saudi Arabia

Middle East seeks bigger role in oil company operations

By Don E. Lambert, WORLD OIL Staff

THE MIDDLE EAST oil and gas picture is changing rapidly.

Recent downward trends in world oil prices have prompted some nations to demand a larger share of income from international oil company operations. Others are expected to follow suit. Various plans are being studied with a view toward setting up a proration program among major oil exporting nations.

On top of this, serious thought is being given to export plans for the region's vast natural gas reserves.

With 61 percent of the world's crude oil reserves and petroleum exports averaging more than 5 million barrels per day during the first six months of 1961, it is obvious that any new policy or marketing plan established in the Middle East will sharply affect every other producing nation in the world.

To clearly define the new developments in this area, and the motives behind them, WORLD OIL was granted an exclusive interview with Saudi Arabia's Minister of Petroleum and Mineral Resources Abdullah H. Tariki. Drilling Editor Jack Earl conducted the interview in Tariki's office at Riyadh.

WORLD OIL acknowledges that many of the answers concerning prices, costs, national policies and marketing plans do not concur with those of international operating companies. Nor is there a direct reference to the many material contributions international companies have made to the oil producing nations involved.

However, the intention is to apprise the Free World oil and gas industry of the fast-changing international oil scene as it is viewed by one Middle East leader.

Q. *What is the current average cost to find, develop and produce a barrel of Middle East crude oil?*

A. About 17 cents.

Drilling Editor Jack Earl visits with Saudi Arabia's Minister of Petroleum and Mineral Resources Abdullah H. Tariki in his private office during WORLD OIL's exclusive interview on current international oil developments.

Q. *What is the average cost per barrel on arrival at U.S. ports?*

A. Two dollars and thirty cents.

Q. *What are the current markets for Middle East petroleum?*

A. Here is a list of Saudi Arabian exports of crude oil and refined products to ten principal importers for 1956 and 1960, showing a five-year trend.

Country	Exports 1956 B/D	Exports 1960 B/D	% Change
Japan	116,100	120,000	+3.4
Italy	111,800	110,200	—1.4
Germany	56,400	109,000	+95
United States	72,000	79,000	+7
Netherlands	43,300	78,400	+81
France	48,600	60,600	+24.7
India	32,700	43,900	+34.2
Spain	33,600	38,600	+15
Australia	10,300	35,600	+247.5
United Kingdom	12,200	20,500	+68
Total Exports	964,166	1,217,881	+26.3

Similar figures are not available for other Middle East oil exporting countries. However, the following table on 1956-1959 distribution of total Middle East oil production might be of significance in this respect:

	Millions of Barrels		
	1956	1958	1959
Total M. E. production	1,263	1,577	1,671
M. E. consumption	139	168	184
Exports to U.S.A.	103	123	134
Exports to W. Europe	651	810	915
Exports to other destinations	370	476	438

". . . 1.87 billion cubic feet of gas is being flared in the Middle East every day . . . and so it is lost forever for both the producing and energy-hungry nations."

Q. *What are your plans to market Middle East natural gas reserves?*

A. The surplus amount of natural gas after all uses for energy and injection in the Middle East is 1.87 billion cubic feet per day. This amount is being flared every day, and so it is lost forever for both the producing and energy-hungry nations.

Markets for natural gas and LPG are widely established in the world, especially in the United States, Europe and Japan. Various uses for this cheap and suitable source of energy have been well established. Various predictions show that an increasing quantity of natural gas and LPG will be used and imported in the near and remote future both for energy uses and petrochemicals.

An important feature of the natural gas trade in the future is that it will be utilized in fields that will not compete with oil.

Natural gas will replace more of coal rather than oil in the future pattern of consumption of energy in industrialized countries. It will then supplement oil consumption.

The Middle East (and Saudi Arabia) is currently producing, utilizing and flaring the following quantities:

	Production	Utilization		
		Energy	Injection	Surplus
Saudi Arabia (Aramco)	750	90	460	200
Other Middle East	2,050	140	240	1,670
Total M. E.	2,800	230	700	1,870

(All figures in millions of cubic feet per day)

The surplus quantities should be sold as a liquefied fuel in the world energy markets, or utilized locally as a raw material for petrochemicals, or at last injected in the oil reservoirs for the maintenance of pressure and/or for storage for future production.

The total gas reserves of Saudi Arabia are estimated to be 26.3 trillion cubic feet as of January 1, 1959. The potential markets will be the same as for oil, but mainly they will be the highly industrialized countries.

If, after allowing for other uses of gas a surplus is still found, it seems inevitable that methane tankers shall

Signs of changes in Middle East

Here are two recent examples of the action major oil exporting countries are making to obtain a larger share of profits from international oil companies operating in their areas:

Indonesia. President Sukarno has decreed that the three major foreign companies (American Stanvac, Caltex and British Shell group) operating in his country will have to operate as government contractors on a 60-40 basis immediately. Previously the companies operated on a 50-50 split. Indonesia is the world's ninth largest oil producer.

Iraq. Prime Minister Abdel Karim Kassem is making a bid to secure a 20 percent participation in the capital of Iraq Petroleum Company and a possible change in the existing 50-50 profit sharing agreement. The firm is jointly owned by Standard Oil Company (New Jersey), Royal Dutch Shell, Mobil, British Petroleum, and Companie Francais Des Petroles. Iraq is the world's seventh largest oil producing nation.

be used for the loading and shipment of Middle East excess methane.

Q. *Have petroleum markets for Middle East crude declined in Western Europe since the development of oil and gas production in North Africa?*

A. The following figures will show that during 1960 more of Middle East oil was destined toward West Europe. Saudi Arabian Exports to West Europe were as follows:

1958	150,653,000	Barrels
1959	164,415,175	"
1960	174,392,967	"
1st half 1961	92,928,618	"
1st half 1960	87,870,517	"

For Kuwait the trend was the same and more of Kuwaiti oil was exported to Western Europe during 1960 as shown below.

1958	302,200,000	barrels
1959	289,400,000	"
1960	345,500,000	"

Iraq Exports show similar increases. This is illustrated by the increase in pipe line thruput during 1960. It is presumed, however, that increases in the pipe line throughput was due to more exports to West Europe (since Middle East exports to the United States were rather limited by U.S. restrictions).

The following figures show the increase in Iraqi pipe line throughput:

1958	470,080	bpd
1959	567,643	bpd
1960	700,965	bpd
1st 6 months 1961	751,137	bpd

These figures show that the Middle East has maintained its position as the principal supplier of West Europe's increasing oil requirements, notwithstanding the development of other sources of oil.

The Trans-Mediterranean pipe line has not yet been built. It is still contemplated by concerned oil companies. The investment incurred shall be tremendous and there are still very difficult technical problems to be solved.

It seems quite unrealistic now to discuss the impact that such a pipeline will have on the Middle East since many economic alternatives have to be contemplated simultaneously while looking forward to the construction of this pipeline.

Q. *Has Russian "dumping" of crude oil on Free World markets affected your export totals?*

A. Middle East oil production has been always and also recently increasing. Oil exports are only another phase of the situation since all production is practically exported either in the form of crude oil and/or refined products. The following figures show Middle East oil production for the years 1958, 1959, 1960 and for the first six months of 1961; the figures indicate only Saudi Arabia, Kuwait, Iran, Iraq and Qatar.

	Barrels Per Day	% Increase.
1958	4,060,000	——
1959	4,416,000	8.8
1960	5,082,000	15.1
First 6 months 1961	5,400,000	6.3

These figures show that Russian so-called dumping has not affected Middle East production and export totals since annual increases are normal.

Q. *What are your plans to offset the intrusion of Russian oil on Free World markets?*

A. Most Russian exports of oil to other countries are made on a barter basis, such as the barter agreements made with Italy and Japan. And thus Russian exports will be limited by the willingness of countries in Western Europe, Africa and Asia to import Russian oil. U.K. has recently refused to buy Russian oil contending that she has a surplus quantity available.

Another limit to the expansion of Russian exports is that Russia itself is in great need for its own oil which is going to be produced in the future to satisfy the requirements of its expanding economy, thus a big surplus will not be available for export.

A United States source reports that Russian fears of adverse effects on Arab opinion killed a deal to supply large quantities of Russian oil to a third state via South Africa. That deal involved about $15 million worth of South African produce. It is also reported that South Africa is losing millions of dollars worth of export business because East Europe countries have stopped buying South African goods.

This shows, however, that Russia does not intend to intrude on all the markets of Middle East oil, and so long as *other* countries are not willing to import Russian oil, there will be no intrusion.

Q. *How are plans progressing to join with Venezuela and others to set up a proration program among major oil exporting nations?*

A. Various plans for setting up a proration program are being considered. These plans contemplate the following proposals:

- Relating historical production to increased demand.
- Relating future OPEC production to estimated rates of growth in free world demand.
- Relating future OPEC production to demand on the basis of historical shares of Free World market.
- Relating future demand to proven reserves.

Consideration will be taken for historical and natural markets of each member of OPEC in the over-all proration program.

Q. *As you know, U.S. crude oil producers are pressing hard to further restrict crude oil imports. What is your reaction to these efforts?*

A. As an exporting country we wish to see our oil exported where it is needed.

We believe that our oil (and the Middle East oil) should supplement and not supplant the oil produced in the United States and other countries of similar status. In this way we are assured that our oil is getting what it is worth by the world consumers, to the satisfaction of our people and to world consumers.

Q. *Also, there are pressures in Washington, D.C., to reduce the 27½ percent depletion provision as it applies to overseas operations. Would you comment on this?*

A. Insofar as our income from oil companies (operating in our country) is concerned, we will not be affected by any reduction of the depletion allowance.

Q. *To what extent have the international oil companies benefited the Middle East producing nations? How can these benefits, also company-government relationships, be improved?*

A. Oil companies in obtaining vast oil areas in the Middle East for their concessions in a world of scarce oil reserves, were able to supply the countries of the world with a large share of their energy requirements in the form of oil, and by doing this huge profits were made.

In earlier stages oil companies paid only a royalty that did not exceed 22 cents for every barrel of oil produced. Yet the huge profits that were made were a sufficient motive to induce the Middle East government to levy taxes that would make their receipts equal 50 percent of the net total profits made by the companies from selling crude oil.

Notwithstanding the 50 percent share of governments, oil companies in the Middle East are still making 60 percent to 70 percent returns on their investments, the highest in the world.

Yet the whole setup of government-company relationship is regulated by oil concession agreements which provide the oil companies with a supreme position to control the production and sale of our main natural resource (which is in fact our life blood), leaving the governments no power at all to decide on matters that would largely affect our economy. Thus governments have no way to control fluctuations in the business that might jeopardize our national safety.

Unless these foreign oil companies become localized in their entities and be separated from their controlling mother companies, and unless host governments would participate in the oil operations of their countries, the benefits accruing from oil will remain greatly deficient, and only restricted to an automatic payment of a certain sum of money.

Q. *What do you feel are Bourguiba's motives in Tunisia's current conflicts with France?*

A. As an Arab country and a free nation we wish to see our sister country completely free from the French imperialism. We believe that President Bourguiba's motives in Tunisia's current conflicts with France are directed toward the complete liberation of his country from the French influence.

Q. *Will Iraq eventually gain control of Kuwait's vast oil reserves?*

A. No.

WHAT CARLA DID TO GOOSE CREEK. These scenes show small portion of damage to Gulf Oil's Goose Creek field south of Baytown, Texas. Six steel derricks gave way to storm tides and 60-70 mph winds. Despite knocked down power lines and damaged equipment, wells were back on production in five days.

What operators learned from Hurricane Carla

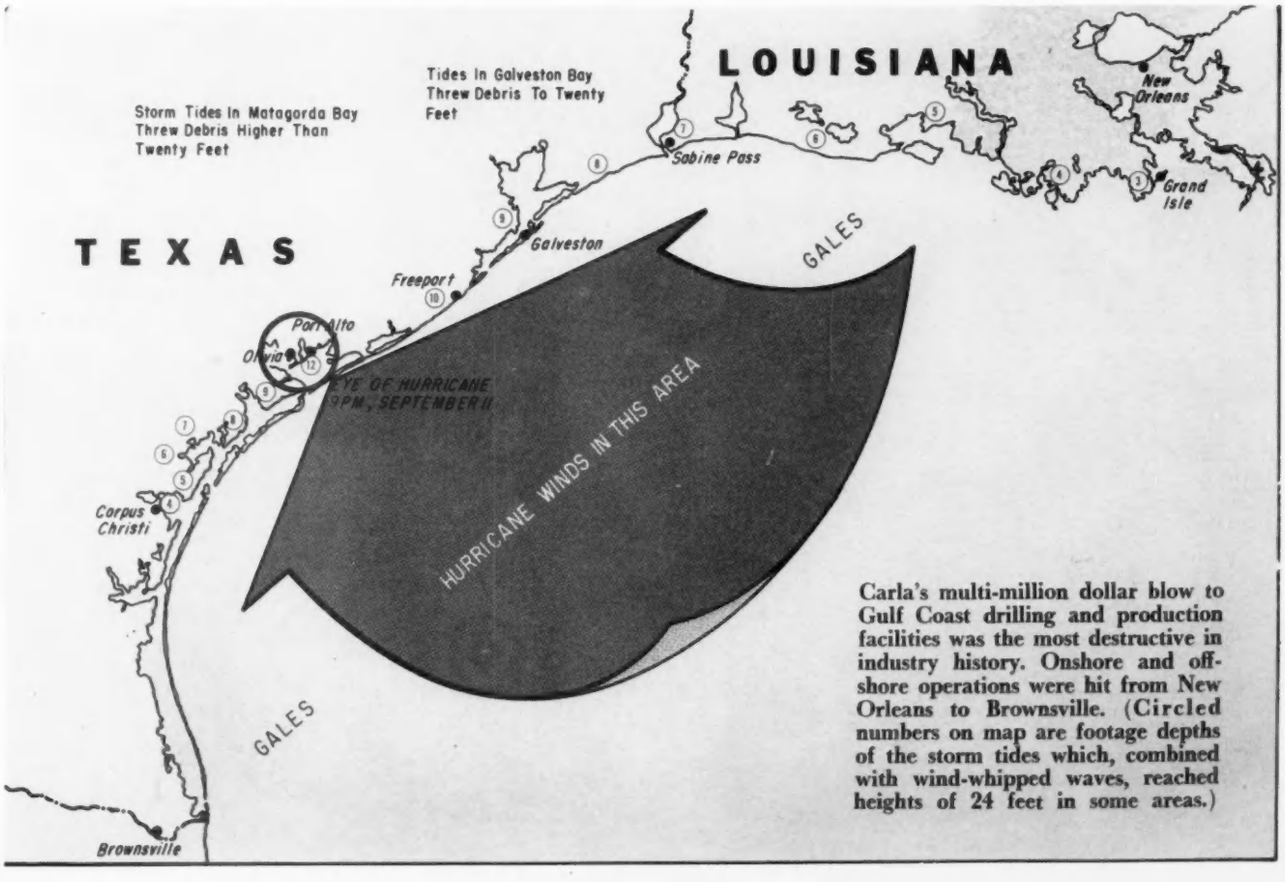
WORLD OIL visited the scenes of damage to obtain this exclusive picture story, damage reports and tips on reducing future losses that you will find on these pages

TAKE 150 BILLION TONS OF WATER pushed and carried by more than 100-mile per hour winds with energy equal to 7 million atom bombs of the Hiroshima type. Add storm tides and waves up to 24 feet high pounding the coast at 20 miles per hour every 12 seconds for more than 48 hours.

This was the destructive punch Hurricane Carla slammed into Texas-Louisiana drilling and production facilities last month. In comparison, Hurricane Flossie (September 1956) carried 20 billion tons of water onto the mainland with energy equivalent to 1 million atom bombs when she swept through offshore and onshore operations in the New Orleans area.

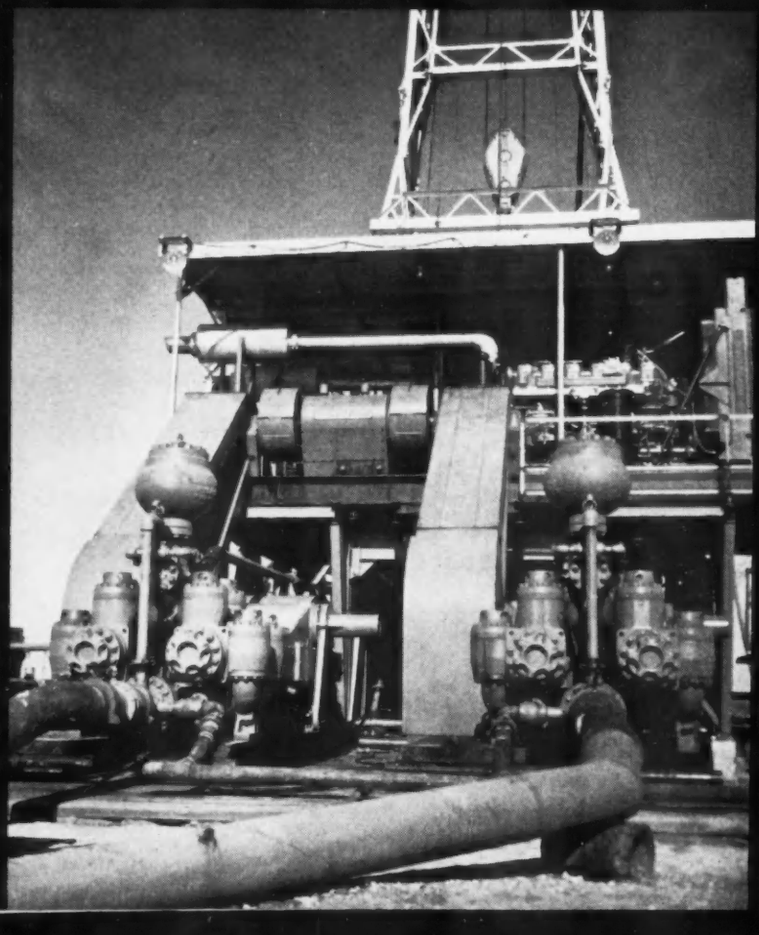
These estimates by the U.S. Weather Bureau and John Freeman, Houston meteorologist and oceanographer, explain why one company with operations up to 300 miles from Carla's center reported more than $1 million damage to production facilities, and $500,000 lost in shutdown time while 27 offshore and onshore rigs sat idle from 2 to 6 days.

Where Hurricane Carla hit the Gulf Coast



Carla's multi-million dollar blow to Gulf Coast drilling and production facilities was the most destructive in industry history. Onshore and offshore operations were hit from New Orleans to Brownsville. (Circled numbers on map are footage depths of the storm tides which, combined with wind-whipped waves, reached heights of 24 feet in some areas.)

Ask J&L Supply about . . .



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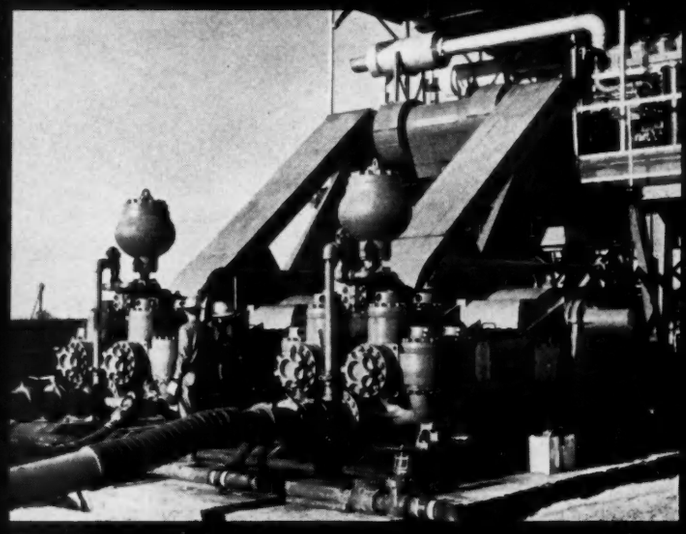

. . . . Gardner-Denver pumps
Gardner-Denver parts
Gardner-Denver service

Drilling crews often find their nearest neighbors to be jack rabbits, coyotes and sidewinders. At night their rig lights may be the only sign of human activity for fifty miles.

Dependable equipment is essential. So more and more drilling contractors have standardized on Gardner-Denver mud pumps.

When service is required, the Gardner-Denver pump can generally be repaired in the field with parts quickly available from a local J&L Supply store.

And it's wise to insist on genuine Gardner-Denver parts to put a pump in like-new condition.

Complete information on any Gardner-Denver pump is available from your local J&L Supply man, or from our Tulsa office, 1437 South Sheridan Road, Tulsa.

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WHAT CARLA DID TO PORT ALTO AND OLIVIA. These twisted masses of steel once were production facilities at Olivia and Port Alto, Texas. Carla's eye whipped into the area with winds of more than 130 mph and storm tides with waves reaching more than 20 feet in height. Both towns were wiped off the map.

What Happened To Texas Operations

This example can be multiplied many times over in counting up the multi-million dollar damage Carla's wind and storm tides inflicted on the industry from New Orleans to Brownsville, Texas.

Following are just a few of the damage reports made available to date:

Company A: 20 offshore and onshore rigs shut down from 2½ to 7 days. Cost of shutdown time: $350,000. Damage to production facilities included tanks turned over, electric motors flooded, salt water disposal wells drenched with water, meters torn up, warehouses demolished, and power lines knocked down. Several boats were sunk.

Company B: Had more water than wind damage. Storm tide damage to production facilities and offshore drilling rigs is estimated at a minimum of $450,000. Final total will be higher. Losses from rig shutdown time and allowable production that will never be recovered total more than $600,000.

Company C: 10 rigs shut down 4-5 days, with cost of shutdown time estimated at $175,000.

Company D: 59 rigs shut down more than 48 hours. Docks were washed away and severe damage was reported on one 10-inch and two 12-inch flow lines.

In Jackson County, Texas, more than 20 miles inland from the Gulf storm tides, but directly in the path of the winds around Carla's eye, damage to oil field property was estimated at $500,000.

Directly south, in Calhoun County, the storm tides and wind made a shambles of small oil and gas fields near the coast line. The little summer resort towns of Olivia and Port Alto were wiped off the map.

More than 40 town lot wells dot the landscape around Olivia. Of 20 tank batteries in the field, at least one tank was gone from each battery—some blown five miles across the bay. Every separator and heater treater was bowled over or damaged. Eighty orifice meters were totally ruined. Warehouses and doghouses disappeared. Production facilities will have to be completely rebuilt from scratch. It will be at least a month before the wells are put back on production. Losses up to $500,000 are estimated.

The same twisted masses of steel that once were meters, tank batteries, separators, heater treaters, and other producing equipment can be seen four miles to the east at Port Alto, only worse. Of 210 homes in the town, the shells of five are left standing.

The same is true for fields around Palacios and other coastal areas east and west of the storm center. Gulf Oil's Goose Creek field south of Baytown, Texas, had six derricks knocked over and extensive damage to other production facilities.

What Happened To Louisiana Operations

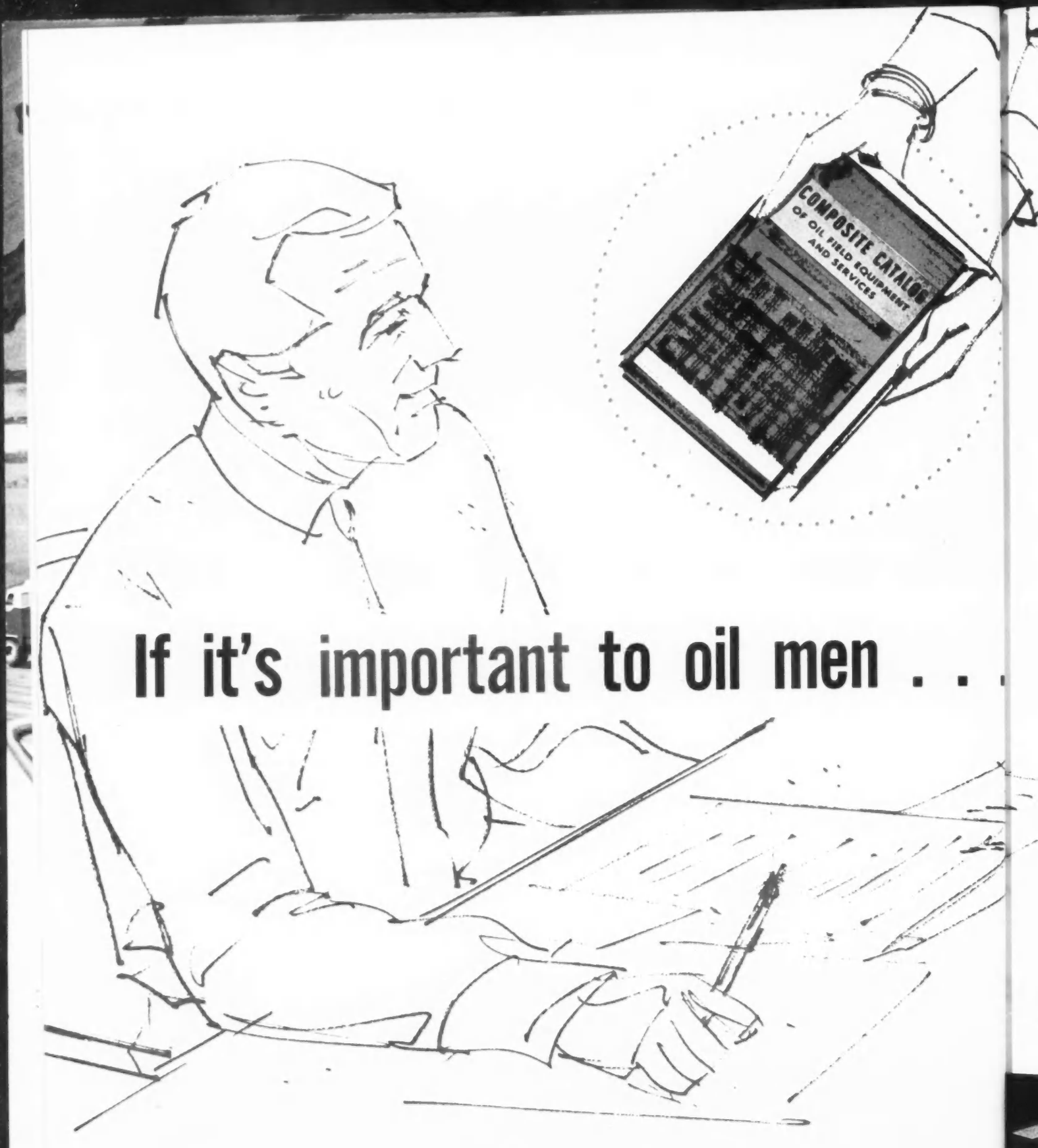
Advance evacuation and battening down reduced offshore losses considerably. However, with waves cresting up to 55 feet, it was impossible to escape some damage.

Penrod Drilling Company of Dallas reported Rig 50, drilling below 15,000 feet near Grand Isle, Louisiana, listed sharply, breaking off the wellhead. Rig 52, which had just finished drilling a dry hole for Placid Oil Company 55 miles south of Marsh Island, Louisiana, disappeared for several hours. The drilling barge, valued at more than $7 million, was found by a helicopter team 50 miles away in relatively good condition.

Louisiana Delta Offshore Corporation's Rig 1, a submersible barge drilling near West Cameron, Louisiana, had 6 feet of water in the pump room. Damage to the $4.5 million rig is estimated at $500,000.

Carla's storm tides picked up the California Com-

Hub deep in water after Carla hit, this workover rig near Pierce, Texas, was back in operation within four days.



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pany's new underwater oil storage unit, complete with producing facilities, and deposited it 3,300 feet away from its original location in good condition. The 20,000-barrel capacity storage battery was filled with 15,000 barrels of crude and 5,000 barrels of salt water. It is in Eugene Island Block 110 off the Louisiana coast.

What Operators Learned From Carla

It is difficult to determine what should be done to reduce onshore production facility losses from storm tides in coastal areas. The cost of designing and installing equipment to withstand water force must be weighed against frequency of occurrence.

Offshore, it is a different story. Many lessons learned from Hurricane Flossie five years ago were not remembered in preparing for Carla.

The following four problems were discussed in 1956 by WORLD OIL:

Evacuation. Nearly 50 men rode out Flossie on tenders and other vessels. Operators, in evaluating the aftermath, said more attention should be given to complete evacuation, doing away with the calculated risk.

This was followed in Hurricane Carla.

Anchoring. Damage from inadequate moorings resulted from both Flossie and Carla.

Suggestions for future storms include putting two 1,500 pound anchors on all tenders. When a storm hits, the tender should be able to swing free in a 360-degree arc with all lines cast off but the storm anchor. The extra anchor should be put over the side with a wire line, ready to drop should the first anchor mooring break or slip.

Offshore flow lines. There was considerable damage to flow line connections and risers during Flossie, and again during Carla.

More study should be given this problem.

Salvaging unattended vessels. Although there was no difficulty during Flossie or Carla, operators have expressed concern about the possibility of outsiders salvaging such vessels in future storms.

Marine lawyers offer the following opinions:

If a vessel is adrift and not under control anyone can board it—make efforts to save it—and bring it into port. However, the salvaging party has no right to ownership of the vessel. Only a right to salvage award.

The owner has a right to reclaim his vessel. However, the salvaging party has right to obtain legal security to protect his salvage claim and that of his crew. Under no circumstance does the salvor or any member of his crew have a right to appropriate anything on the salvaged vessel.

Whenever a vessel is taken for salvage, the owners are advised to contact only their insurors and lawyers—and do that immediately.

What's happening in the oil an

Chadron Arch oil play in **central Nebraska** is being extended northwestward from Red Willow and Frontier counties. Tests indicate first oil production in Lincoln County. Mast Drilling and Chieftain Petroleum Melton 1 swabbed up to 10 barrels hourly from lower Pennsylvanian Cherokee sandstone at about 4,485 feet and Reagan sandstone at 4,500 feet near basement. Perforations were at 4,498-4,501 feet in Reagan . . . **Southern Mississippi** deep Paluxy gas play is developing in Walthall and Marion counties. Series of sands varying up to 50 feet thick are found from 12,400 to 13,300 feet. Sands continue to be tight, requiring combination acidizing and formation fracturing completions . . . Edwards limestone play in **South Texas** evidently is being projected as far north as Polk County, north of Houston. A deep test, reportedly drilled (tight) below 13,000 feet, may seek either Edwards or Woodbine production . . . **Alaska's** Kenai Unit gas field is on production following completion of pipeline to Anchorage, where the first 3,000 gas customers in 49th State will be served . . . Single vs. multiple use of public lands may be issue as proposed **Padre Island National Park** is argued in Congress and Texas Legislature. **Padre Island** is in a good (though probably not prolific) Miocene-Frio oil and gas prospective trend . . . Upward revision of surface taxes is in the wind for **Spain** and **Spanish Sahara** . . . **Algeria's** Ohanet

GAS REGULATION:

FPC Chairman Swidler speaks his mind on gas issues

New FPC Chairman Joseph Swidler's appearance before the Independent Natural Gas Association of America in Houston last month gave producers excellent insight into his philosophy. His years with government-owned Tennessee Valley Authority showed through at every turn—so did his sense of humor.

He appears to be a "consumer" man. Some of his beliefs:

- Consumers must be able to think of natural gas as not only better than other fuels, but cheaper as well.
- Small producers will be decontrolled without new legislation, if the idea "makes sense." Also, if government attorneys approve (he believes they will).
- New legislation clarifying the gas regulation quagmire is not needed—would merely "add to present confusion and uncertainty."
- Believes "area rate proceedings will probably prove to be the most important single tool for developing a sound framework of producer rate regulation." But, prices set must be ceilings, not floors. No rule-of-thumb has been set to establish ceilings.
- He plans to regulate in-place natural gas sales, if attorneys give green light.
- Every effort will be made to cut down ridiculous backlog of cases. Increased FPC budget will be asked for next fiscal year. Decisions of producer and pipe line cases within five months is his goal.

Chairman Swidler displayed a surprising knowledge of the natural gas situation for the short time he has been exposed to its frustrating complexities.

Viewpoints

"... Unless we in this industry collectively recognize and accept our interdependence, and discharge the responsibility that goes with it, then it is inevitable that there shall be more and more attempts on the part of some people to seek government relief."

E. K. Bennett, president
National Oil Jobbers Council

"... Reducing prices or avoiding price increases has great popular appeal. As consumers we all want that. But we cannot have it both ways. We cannot have inflationary wage increases, higher taxes and other rapidly increasing costs on one hand, and enjoy reduced and unrealistic price levels on the other, without endangering national growth and jeopardizing jobs. The sooner all of us in the great American public understand that simple fact, the better."

Roger M. Blough, Chairman of the Board,
United States Steel Corporation

"... I should like to emphasize these things: (1) Secretary Udall believes that a strengthening of our national policies affecting mineral resources is a matter of great urgency. (2) Strengthening of the nation's defense position demands the invaluable assistance of the fuels industry in developing plans. (3) Specifically, the Federal Government needs industry representatives to form an "Executive Reserve," a standby emergency organization, both regional and national in scope. (4) Looking toward peacetime uses, the Federal Government should take no unnecessary steps to dull the cutting edge of fair competition between the various elements of the fuels industry, thus continuing to lower costs and bring about maximum use of these resources."

James K. Carr, Undersecretary
of the Interior

"... It is therefore all the more surprising to hear from some sources the thesis that after oil is found and developed, a 'host' government can, in fact, as a matter of patriotic necessity *should*, declare a one-sided amendment to the agreement which would give them part or all of the investing company's share of the profits.

"Legality aside, if such principle were accepted, the practical effects might well be disastrous. The need of the newly-developing nations for outside capital does not stop with the discovery of oil. New capital investment is then more necessary than ever before.

"Success and good faith on both sides attracts more foreign capital to create more wealth, a better life. But if this is an ascending spiral, one-sided abrogation and bad faith breeds a descending one; new and desperately needed capital investment is 'scared off' and even that already invested seeks to cut activity or escape altogether."

R. G. Follis, Chairman of the Board,
Standard Oil Company of California

nias country

oil field has started production into new 330-mile, 30-inch pipeline extension to the Hassi Messaoud-Bougie system. Ohanet line is to be extended 90 miles southeastward to Edjele field, to provide other Polignac Basin fields with outlets to Bougie and Tunisia . . . **Persian Gulf Islands** are getting brisk wildcatting play. Iranian Oil Exploration and Producing's Lavan 1 on Sheykh Shu'eyb Island was plugged at 10,466 feet; operators moved rig to Qeshm Island to spud new test this month. Same firm tested 3,500 bopd at Bibi Hakimeh 1 wildcat 22 miles southwest of Gachsaran field in south Iran, then moved the rig to Kharg Island to spud another wildcat this month . . . Search for offshore oil continues in **Bahrain** and the **Neutral Zone.**

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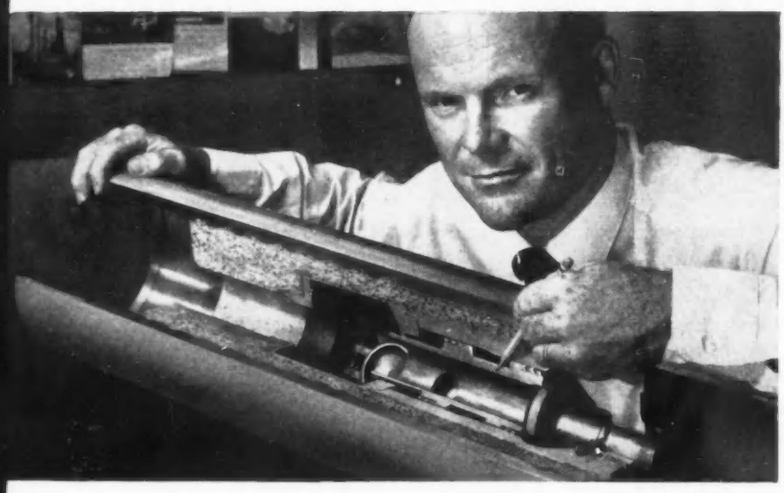

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This precise mechanism automatically fills your casing from the bottom, constantly adjusting the rate of fill to provide maximum relief from destructive pressure surges—regardless of the depth to which it is run.

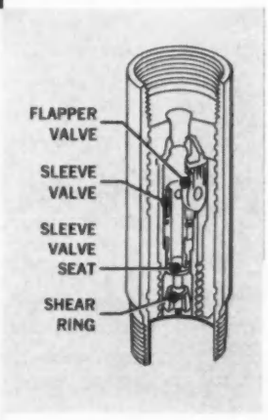
This means you can land casing faster, saving up to 50% on running-in time. This is because you eliminate time-consuming surface filling, and because you can run fast through weak or permeable formations without fear of damaging them. You protect the productivity of your well, and lessen the causes of blowouts, too. The Differential Valve is designed to allow only a 90% casing fill; and, when the rate of lowering slows or stops, the valve closes. Baker Differential equipment thus provides positive action to prevent overfilling.

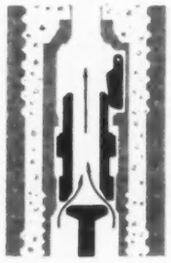
Baker Differential Fill-Up Shoes and Collars may be used in combination, giving the protection of two back-pressure valves and 81% fill.

Yes, Baker Differential equipment belongs in your next casing string—for many reasons. To get the complete story on both regular and circulating Differential, call your Baker man.

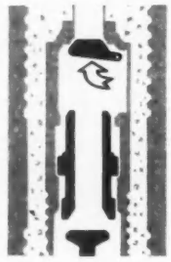
What's in a name?

"*Differential*" doesn't always mean the same thing. In certain equipment it means little more than providing a *fixed* difference by means of a spring. *Baker Differential* works on a difference in areas to balance casing fill with the fluid in the annulus. It takes into consideration differences in depth and running-in speed. It gives instantaneous relief at the point where pressure surges occur—below the shoe. The *difference in differential* is important. Specify *Baker Differential* Equipment.





RUNNING-IN Flapper Valve held open. The Sleeve Valve constantly adjusts fluid entry to maintain the proper rate of fill.



BACK-PRESSURE VALVE Pressuring the casing shears Ring and releases Flapper Valve for cementing or floating. No ball to drop.

DIFFERENTIAL FILL-UP EQUIPMENT

BAKER OIL TOOLS, INC. HOUSTON | LOS ANGELES | NEW YORK

BAKER

Production and imports provide surplus oils

By World Oil Staff

THE INDUSTRY CONTINUES to face the problem of holding supply of petroleum within sluggish demand. New supply still comes on the market in volumes somewhat exceeding requirements. The excess in August was primarily in domestic production of crude oil and natural gas liquids. Total imports were lower than in August last year.

For this year as a whole, however, imports as well as domestic production have been 3 to 4 percent above last year, while total demand for petroleum is up only one half of one percent.

During August, total new supply averaged 9,712,000 barrels daily, an increase of 163,000 barrels daily or 1.7 percent over that month last year. Meanwhile, total demand for petroleum was down a few thousand barrels daily.

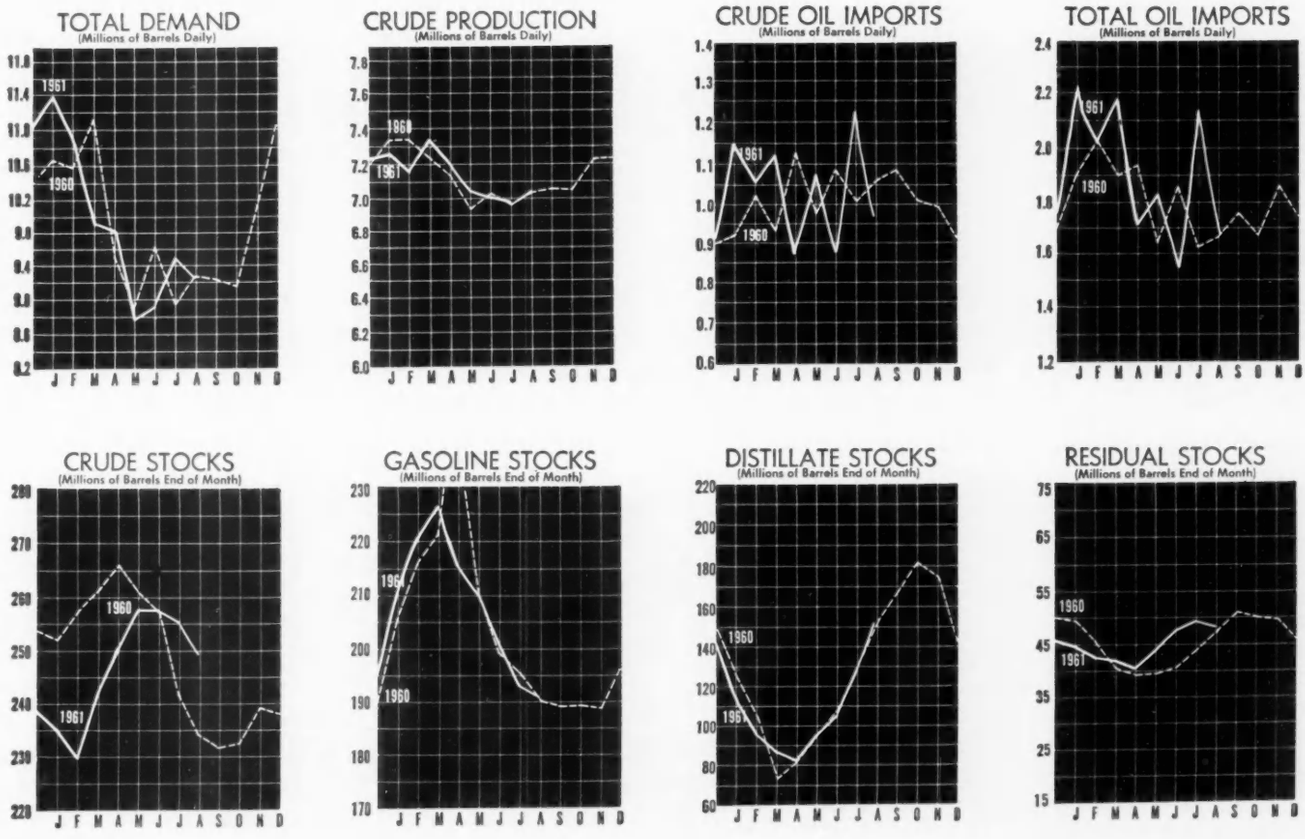
Stocks. With new supply excessive, stocks of all oils in the aggregate increased by 14 million barrels or an average of 442,000 barrels daily in August, compared with a rise of 276,000 bpd in that month last year.

The stocks of all oils totaled 844 million barrels at the end of August, an increase of 42 million barrels or 5.2 percent over one year previously. Fortunately, the stocks of the four major products of the industry have not participated materially in this large increase. Stocks of gasoline, distillate fuel oil, and kerosine were about the same on August 31, 1961, as a year earlier, and stocks of residual fuel oil were up only moderately.

Stocks of the raw materials are substantially above a year ago. Crude oil stocks of 249.2 million barrels August 31, 1961, were 15.1 million barrels or 6.5 percent above the 234.1 million held a year earlier. Natural gas liquids in storage at the end of August totaled 40.8 million barrels, an increase of 7.6 million barrels or 22.9 percent over one year before.

Another sector where stocks are generally excessive is that of miscel-

Petroleum Trends...



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laneous products other than the four major items. Combined, they totaled 128 million barrels August 31, an increase of 16 million barrels or 14.4 percent from a year earlier.

Refinery runs were increased considerably in August and were 225,000 barrels daily or 2.7 percent above that month last year in averaging 8,475,000 bpd. This higher level of runs to stills was not needed, in view of the failure of demand to equal that last year.

Prior to August, however, refinery runs had been held fairly well in line with demand. For the first 8 months of this year, they averaged 8,183,000 barrels daily, an increase of only 74,000 barrels or 0.9 percent over last year. This gain was only a little more than that of 53,000 bpd or 0.5 percent in total demand for all oils.

Demand. The 0.5 percent increase in total demand in this year's first 8 months was determined to an important extent by the gain of only 0.6 percent for gasoline, the industry's principal product. The gasoline demand continued slow in August, being down 34,000 bpd or 0.8 percent from August last year in averaging 4,467,000 bpd.

Distillate fuel oil demand was up 2.1 percent or 38,000 bpd in the first 8 months of 1961, averaging 1,889,000 bpd. It showed a larger gain than that in August.

Demand for kerosine continues to be the best recorded by the industry's major products. It was up 9.5 percent or 32,000 bpd in the first 8 months, averaging 369,000 bpd. The gain in August was 14.4 percent. Increased use by commercial jet planes accounts for the strong demand for kerosine this year.

Residual fuel oil demand has been affected adversely by the recession of industrial activity in 1961. For the first 8 months, residual demand averaged 1,528,000 bpd, a decrease of 69,000 barrels daily or 4.3 percent from last year. However, residual demand is picking up as the business recovery proceeds. In August it was up 7.2 percent or 89,000 barrels in averaging 1,319,000 bpd.

Total demand for all other oils in this year's first 8 months showed an increase of 1.4 percent or 25,000 bpd in averaging 1,832,000 bpd.

U.S. Petroleum Demand and Supply (Thous. Bbls. Daily)

ITEM	August 1961	August 1960	% Diff.	July 1961	January-August 1961	January-August 1960	% Diff.
DEMAND							
All Oils, Total Demand	9,270	9,274	.....	9,583	9,836	9,783	+ 0.5
Domestic Demand	9,070	9,079	— 0.1	9,398	9,653	9,601	+ 0.5
Export Demand	200	194	+ 3.1	185	183	210	—12.9
Gasoline, Total Demand	4,467	4,501	— 0.8	4,526	4,218	4,191	+ 0.6
Distillate, Total Demand	1,367	1,222	+11.9	1,321	1,889	1,851	+ 2.1
Kerosine, Total Demand	317	277	+14.4	285	369	337	+ 9.5
Residual, Total Demand	1,319	1,230	+ 7.2	1,383	1,528	1,597	— 4.3
Other Oils, Total Demand	1,800	2,044	—11.9	2,068	1,832	1,807	+ 1.4
CHANGE IN STOCKS							
All Oils, Change in Stocks	+442	+276	.....	+461	+249	—27	.....
NEW SUPPLY							
Total New Supply	9,712	9,549	+ 1.7	10,044	10,084	9,783	+ 3.1
Domestic Production, Total	8,043	7,863	+ 2.3	7,912	8,177	7,953	+ 2.8
Crude Oil	7,053	6,940	+ 1.6	6,957	7,195	7,027	+ 2.4
Natural Gas Liquids	990	923	+ 7.3	955	982	926	+ 6.0
Imports, Total	1,669	1,686	— 1.0	2,132	1,908	1,831	+ 4.2
Refined Products	681	629	+ 8.3	898	869	811	+ 7.2
Crude Oil, Total	988	1,057	— 6.5	1,234	1,039	1,020	+ 1.9
Crude, East of California	721	725	— 0.6	811	744	752	— 1.1
CRUDE RUNS							
Crude Runs to Stills	8,475	8,250	+ 2.7	8,242	8,183	8,109	+ 0.9
Domestic Crude	7,403	7,194	+ 2.9	7,144	7,151	7,092	+ 0.8
Foreign	1,072	1,056	+ 1.5	1,098	1,032	1,017	+ 1.5

U.S. Stocks of Oils (Million Bbls. at End of Month)

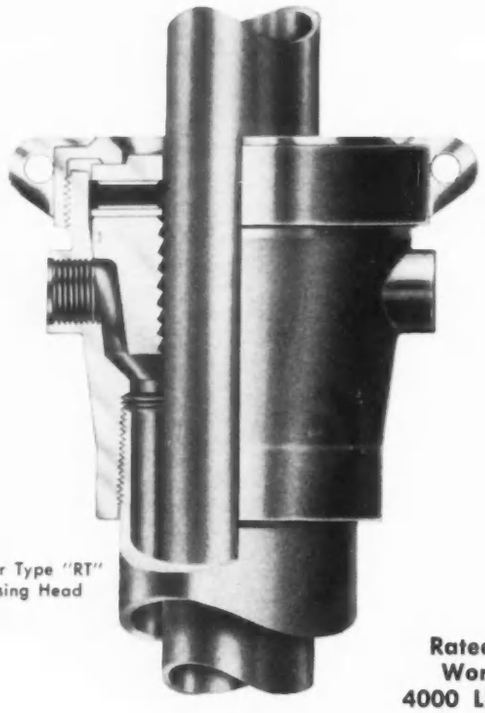
KIND OF OIL	TOTAL IN U.S. Aug. 1961	TOTAL IN U.S. Aug. 1960	TOTAL IN U.S. % Diff.	TOTAL IN U.S. July 1961	EAST OF CALIFORNIA Aug. 1961	EAST OF CALIFORNIA Aug. 1960	EAST OF CALIFORNIA % Diff.	EAST OF CALIFORNIA July 1961
All Oils	844.0	802.3	+ 5.2	830.3	.....	.....	.....	.....
Crude Oil	249.2	234.1	+ 6.5	255.9	220.9	203.5	+ 8.6	256.0
Natural Gas Liquids	40.8	33.2	+22.9	39.5	.....	.....	.....	.....
Gasoline	190.3	190.3	.....	193.5	165.4	163.5	+ 1.2	167.8
Distillate Fuel Oil	152.3	152.2	+ 0.1	131.7	137.2	138.1	— 0.7	116.6
Kerosine	34.1	33.4	+ 2.1	32.1	32.6	31.9	+ 2.2	30.4
Residual Fuel	49.3	47.2	+ 4.4	49.8	31.6	31.6	.....	31.4
Other Products	128.0	111.9	+14.4	127.8	.....	.....	.....	.....

U.S. Crude Oil Production, by States (Thous. Bbls.)

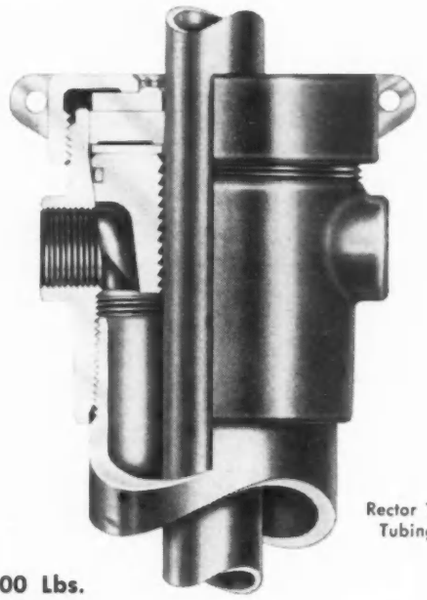
STATE or DISTRICT	Daily Average for Month Aug. 1961	Aug. 1960	% Diff.	July 1961	Total, January-August 1961	1960	% Diff.
Alabama	17.7	21.2	— 16.5	19.4	4,725	4,695	+ 0.6
Arkansas	76.8	78.3	— 1.9	75.2	19,580	19,103	+ 2.5
California	813.3	828.6	— 1.9	817.4	200,196	203,042	— 1.4
Colorado	125.9	125.6	+ 0.2	126.2	31,283	31,168	+ 0.4
Florida	1.0	1.0	.....	1.0	247	256	— 3.5
Illinois	211.5	218.3	— 3.1	209.9	52,159	52,615	— 0.9
Indiana	29.8	34.7	— 14.1	29.8	7,429	7,772	— 4.4
Kansas	307.2	315.7	— 2.7	303.5	75,189	75,157	.....
Kentucky	50.7	60.4	— 16.1	50.9	12,492	14,617	— 14.5
Louisiana	1,132.2	1,051.2	+ 7.7	1,125.6	280,300	259,499	+ 8.0
North	111.2	129.7	— 14.3	111.4	30,451	30,628	— 0.6
South	1,021.0	921.5	+ 10.8	1,014.2	249,849	228,871	+ 9.2
Michigan	56.0	46.9	+ 19.4	56.0	13,224	9,420	+ 40.4
Mississippi	150.3	138.9	+ 8.2	150.5	36,187	34,340	+ 5.4
Mo.-So.-Dak.-Tenn.	0.6	1.0	— 40.0	0.7	226	229	— 1.3
Montana	86.0	84.4	+ 1.9	84.8	20,279	20,064	+ 1.1
Nebraska	63.7	72.5	— 12.1	61.4	16,328	16,103	+ 1.4
Nev.-Wash.-Alaska-Ariz.	22.0	1.2	+733.3	19.4	3,508	209	+578.5
New Mexico	315.2	299.8	+ 5.1	294.3	74,745	72,302	+ 3.4
Southeast	271.6	255.4	+ 6.3	255.4	64,090	61,131	+ 4.8
Northwest	43.6	44.4	— 1.8	38.9	10,655	11,171	— 4.6
New York-Penna.	19.2	23.0	— 16.5	19.7	4,917	5,427	— 9.4
North Dakota	57.1	66.9	— 14.7	52.6	14,228	14,173	+ 0.4
Ohio	13.4	14.4	— 6.9	13.4	3,309	3,349	— 1.2
Oklahoma	503.8	511.0	— 1.4	504.6	128,175	129,207	— 0.8
Texas	2,505.5	2,454.4	+ 2.1	2,451.5	628,325	627,434	+ 0.1
Dist. 1: South Central	44.7	43.2	+ 3.5	44.6	11,208	10,739	+ 4.4
Dist. 2: Middle Gulf	107.9	103.7	+ 4.1	105.1	27,331	27,840	— 1.8
Dist. 3: Upper Gulf	350.0	344.0	+ 1.7	341.0	85,391	87,330	— 2.2
Dist. 4: Lower Gulf-S.W.	188.7	182.7	+ 3.3	180.6	46,374	45,931	+ 1.0
Dist. 5: East Central	27.7	26.4	+ 4.9	27.6	6,738	6,656	+ 1.2
Dist. 6: Northeast	248.1	237.8	+ 4.3	233.8	60,983	60,330	+ 1.1
Dist. 7-B: North Central	125.3	128.1	— 2.2	123.5	30,701	31,598	— 2.8
Dist. 7-C: West Central	107.1	112.2	— 4.6	113.9	28,287	29,904	— 5.4
Dist. 8: West	1,005.0	959.3	+ 4.8	1,003.1	253,473	248,188	+ 2.1
Dist. 9: North	194.4	194.6	— 0.1	171.5	46,578	47,591	— 2.1
Dist. 10: Panhandle	106.7	108.1	— 1.3	106.7	25,633	26,474	— 3.2
Utah	83.0	94.8	— 12.5	84.2	22,221	25,335	— 12.3
Virginia	.....	.....	.....	.....	3	4	— 25.0
West Virginia	7.5	6.7	+ 11.9	7.8	1,717	1,513	+ 13.5
Wyoming	403.3	389.3	+ 3.6	397.5	97,171	87,449	+ 11.1
Total United States	7,052.7	6,940.2	+ 1.6	6,957.3	1,748,163	1,714,482	+ 2.0

Sources for above 3 tables: Bureau of Mines monthly reports except last two months based on API and B. of M. weekly reports and WORLD OIL estimates and Texas districts from API.

Rector
Non-Flanged Tubing and Casing Heads



Rector Type "RT" Casing Head



Rector Type "R" Tubing Head

Rated at 2000 Lbs. Working Pressure
4000 Lbs. Test Pressure

Quality at Low Cost

For trouble free service at lowest cost you can depend on RECTOR non-flanged well head equipment. Constructed from pre-tested steel alloy to meet exacting engineering specifications, RECTOR non-flanged tubing heads and casing heads are designed to satisfy the widest range of producing conditions economically.

CHECK THESE IMPORTANT FEATURES

SUSPENSION – Casing heads have case-hardened three-segment type *hinged* slips of ribbed construction to allow full flow to outlets. Tubing heads use same or threaded type of suspension. A special threaded or slip-type mandrel hanger is also available for use with Kobe pump or dual string tubing completion.

SEAL — Both casing and tubing heads have an oil-resistant pack-off which is forced into sealing position by a split packing gland tightened by a cap threaded to the body.

SIDE OUTLETS – Both casing and tubing heads are available with 2″, 2½″ or 3″ threaded side outlets.

BOTTOM CONNECTIONS – Casing heads have male or female threaded bottom connections. Type "RT" is available through 10¾″. Type "R" tubing heads are available with male or female threaded bottom, 4½″ through 7″, also all flange sizes and series with standard API ring groove and bolting arrangement.

Rector casing and tubing heads are available through your favorite supply store.
For more information see your Rector representative.

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Rig activity shows upward trend

By World Oil Staff

Domestic drilling rig activity improved steadily during the summer months. At the end of July, 3,674 rigs were operating, up 193 or 5.9 percent over June 30 totals—and by the end of August the total had increased 104 rigs, or 2.8 percent, to 3,778.

The July 31 total was 268 rigs or 7.9 percent better than the same 1960 date. The August 31 total was up 205 rigs or 5.7 percent over August 1960.

New well completions totaled 3,896 during August, down 113 wells or 2.8 percent from July's end. And 187 wells or 4.5 percent less than the August 1960 total.

Footage drilled totaled 16.3 million feet during August, down 600,000 feet or 3.6 percent from July and 4.1 percent from the 17 million feet drilled during the same 1960 period.

Wildcat activity dropped sharply in August, totaling 670 wells for a drop of 107 or 13.8 percent from the July total of 777, and 140 wells or 17.3 percent from the 810 wildcats drilled during August 1960.

U.S. Drilling Activity in August and First Eight Months, 1961

STATE or DISTRICT	TOTAL NEW WELLS COMPLETED									WILDCATS COMPLETED						†Active Rigs End of Month
	August							January-August		August					Jan.-Aug. Total	
	Oil	Dist.	Gas	Dry	Service	Total Wells	Total Footage	Total Wells	Total Footage	Oil	Dist.	Gas	Dry	Total Wells		
Alabama	1	....	....	....	....	1	11,600	31	344,356	....	....	....	....	....	5	4
Alaska	2	....	2	2	....	6	59,612	32	328,610	....	....	1	2	3	8	12
Arizona	....	....	....	....	....	....	....	11	25,416	....	....	....	....	....	7	4
Arkansas	16	....	3	27	....	46	175,080	328	1,242,221	....	....	....	16	16	66	48
California	126	....	16	38	....	180	689,542	1,138	4,972,336	....	....	....	19	19	174	139
Colorado	3	....	6	30	....	39	183,240	353	1,703,825	3	....	1	16	20	182	60
Illinois	88	....	7	90	....	185	392,065	1,141	2,513,951	1	....	....	44	45	310	297
Indiana	20	....	1	46	....	67	99,395	499	756,608	....	....	1	11	12	138	95
Kansas	195	....	26	166	25	412	1,465,010	3,154	11,262,300	2	....	2	49	53	483	223
Kentucky	72	....	20	97	4	193	167,108	1,440	1,118,685	....	....	....	1	1	35	157
Louisiana	148	13	42	152	....	355	2,561,533	2,437	18,309,401	....	....	....	53	53	351	328
North	62	....	29	62	....	153	494,734	983	3,228,495	....	....	....	25	25	158	85
South	86	13	13	90	....	202	2,066,799	1,454	15,080,906	....	....	....	28	28	193	243
* Gulf of Mexico	31	3	3	14	....	51	522,035	355	3,668,087	....	....	....	2	2	28	54
Michigan	26	....	4	51	1	82	246,139	455	1,470,316	1	....	....	30	31	174	101
Mississippi	17	....	4	32	....	53	464,196	370	3,654,607	1	....	....	18	19	111	69
Missouri	....	....	....	3	....	3	4,644	12	18,536	....	....	....	....	....	.....	1
Montana	12	....	2	17	1	32	164,520	280	1,484,268	....	....	....	12	12	125	30
Nebraska	23	....	....	55	....	78	374,490	693	3,147,110	3	....	....	40	43	340	22
New Mexico	71	....	10	40	....	121	627,102	1,068	5,569,722	2	....	....	17	19	161	148
Southeast	65	....	....	34	....	99	512,113	703	3,757,756	2	....	....	13	15	128	82
Northwest	6	....	10	6	....	22	114,989	365	1,811,966	....	....	....	4	4	33	66
New York	7	....	8	8	18	41	74,250	255	441,750	....	....	....	....	....	.....	25
North Dakota	10	....	....	12	....	22	142,850	168	1,037,940	....	....	....	7	7	42	14
Ohio	34	....	17	28	....	79	195,494	641	1,585,198	....	....	1	4	5	34	121
Oklahoma	187	6	46	137	31	407	1,794,122	3,135	11,855,341	6	....	2	21	29	255	588
Pennsylvania	24	....	14	8	17	63	151,129	397	1,040,797	....	....	2	4	6	26	78
South Dakota	....	....	....	....	....	.....	.....	4	23,500	....	....	....	....	....	4	.....
Tennessee	....	....	....	4	....	4	3,949	63	46,894	....	....	....	2	2	32	15
Texas	667	....	93	428	29	1,217	5,483,295	9,547	43,423,875	12	....	5	226	243	1,983	913
District—																
1: South Central	35	....	5	45	....	85	233,836	548	1,545,059	....	....	1	34	35	191	52
2: Middle Gulf	17	....	11	32	....	60	393,190	541	3,599,520	1	....	1	18	20	176	62
3: Upper Gulf	39	....	7	41	....	87	612,883	792	5,326,000	1	....	....	14	15	179	105
* Gulf of Mexico	....	....	....	1	....	1	13,425	6	63,028	....	....	....	1	1	5	3
4: Lower Gulf-S.W.	28	....	15	31	....	74	453,027	862	4,706,151	....	....	....	18	18	214	100
5: East Central	11	....	1	18	....	30	195,060	175	1,100,854	....	....	....	16	16	92	24
6: Northeast	45	....	2	29	....	76	390,111	641	3,307,317	....	....	....	16	16	99	49
7-B: North Central	68	....	7	74	....	149	457,270	1,195	3,641,790	1	....	....	39	40	351	76
7-C: West Central	40	....	4	14	....	58	259,887	432	1,941,922	4	....	....	12	16	149	85
8: West	180	....	4	47	14	245	1,256,538	1,867	10,145,873	4	....	....	21	25	278	170
9: North	152	....	11	73	15	251	690,046	1,732	4,578,259	1	....	2	27	30	204	117
10: Panhandle	52	....	26	24	....	102	541,447	762	3,531,130	....	....	1	11	12	50	73
Utah	5	....	....	5	....	10	63,534	142	846,014	1	....	....	3	4	57	42
Washington	....	....	....	....	....	.....	.....	10	42,620	....	....	....	....	....	8	1
West Virginia	31	....	66	20	....	117	285,703	704	1,761,839	....	....	....	....	....	.....	175
Wyoming	35	....	5	35	2	77	381,602	576	3,002,863	2	....	1	25	28	199	62
Others	....	....	1	1	....	2	12,406	26	137,029	....	....	....	....	....	15	6
Total U.S., August, 1961	1,820	19	393	1,532	128	3,892	16,273,610	29,110	123,167,928	34	....	16	620	670	5,325	3,778
July, 1961	1,833	42	435	1,571	124	4,005	16,914,294	.....	.....	53	3	24	697	777	.....	3,674
August, 1960	1,915	63	427	1,557	123	4,085	17,058,512	30,687	128,128,391	41	2	22	745	810	6,129	3,573
Western Canada August, 1961	140	....	30	49	....	219	1,210,011	1,472	8,339,094	....	....	....	....	....	....	172
July, 1961	127	....	31	60	3	221	1,217,605	.....	.....	....	....	....	....	....	....	149
August, 1960	147	....	33	56	16	252	1,397,301	1,668	9,089,696	....	....	....	....	....	....	173

* Gulf of Mexico wells are included in their respective district totals. † Includes wells rigging up, drilling, and temporarily shut-down.

Good Wells Make Good News

Recent Profitable Treatments Using Special Dowell Products and Services

October, 1961

While many oil and gas operators associate Dowell with stimulation and cementing services only, Dowell offers a wide variety of products and "auxiliary" services to help operators improve their wells. Here are four recent examples of Dowell products and "auxiliary" services in use:

- **Stonewall County, West Texas** (Old Oil Well) Scale buildup had shut off production from this well. Operator treated using 110 gallons Versene® 100 chelating agent mixed with 265 gallons fresh water. The solution was dumped down tubing with well dry, and rods were run in hole. Well was allowed to set for 24 hours, then Versene 100 was circulated with well pump for 48 hours. *Flush production after treatment was 60 bopd. After two weeks, production had leveled off at 17 to 22 bopd.*

- **Caddo County, Oklahoma** (Old Oil Well) This well was originally completed open hole. A gor of 2000 limited oil production to 90 bopd. Operator set liner and Dowell cut notch at 6020 feet using Abrasijet®. Well was then fractured by Dowell. *After treatment, well produced 200 bopd with a gor of only 150. Well was not producing at capacity. Operator attributes success of workover to single notch cut by Abrasijet.*

- **Kern County, California** (Old Oil Well) Production had declined due to a scale buildup in a 5½-inch, 80-mesh screen liner set from 3068 to 3131 feet. Plugging was nearly complete. Tubing weight could be set on top of scale buildup. Dowell cleaned by jetting 10,000 gallons three percent acid through a special jet gun with five downward-pointing nozzles. Injection rate was 4 bpm. Tubing was lowered at three feet per minute while jetting. *Production increased 86 percent after treatment.*

- **Wichita County, North Texas** (New Oil Well) This well was completed with open hole from 871 to 886 feet. It yielded only salt water despite the fact that apparent oil shows were encountered from 871 to 878 and from 881 to 886 feet. Further investigation revealed that upper sand was water and lower sand could not produce through mud block and head of water from upper zone. Dowell used Abrasijet at 883 feet and fractured. *After treatment, well produced 16 bopd allowable. Operator reports that economic loss was converted to profitable producer.*

Talk over your production problems with a Dowell representative. The chances are good that he has a service or product that can help you reduce your costs and increase your profits. Dowell services and products are offered in North and South America, Europe, North Africa and Iran. Dowell, Tulsa 14, Oklahoma.

SERVICES FOR THE OIL & GAS INDUSTRY DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

A message from AAODC's president

By John J. Moran
President, AAODC, Wichita Falls, Texas

DRILLING CONTRACTORS during the past year have had to contend with curtailed drilling activities, depressed prices, and gradual increases in supplies and labor costs.

Rig manufacturers have reduced their output of new rigs because of market conditions. Drilling contractors, in general, cannot justify the substantial investment required for new equipment since present drilling prices do not offer a profit margin large enough to pay for it.

John J. Moran

Many contractors face the problem of acquiring enough usable drill pipe for rigs they currently are operating, and they have gone to the used equipment market in an effort to supply their needs. This has made the used equipment sales rather good, but some time this source will be depleted and, rather than invest in new drill pipe, some contractors will be forced to stack their rigs.

Factors contractors face. Factors that have brought this condition to the drilling industry are still very much with us and have remained basically unchanged. The producing segment of the oil industry is continuously faced with curtailed production on both old and new wells. Often it is not economically feasible for producers to explore a promising area since, even if a good discovery is made, they cannot sell enough products from the well to justify the investment.

Practically all producing companies have initiated economy drives within their organizations in an effort to relieve their own financial strain, and this has been passed down to all the suppliers, service establishments, and contractors that work for them.

Labor problems for the drilling industry continue to multiply. Wages for drilling crews have not kept pace with competition from other fields, and trained crewman are leaving their jobs for better pay, steadier employment, and possibly better working conditions. New personnel are not being attracted to the industry for the same reasons. Inexperienced help always is a tremendous expense for any endeavor, and this is a problem that will most certainly have to be solved if drilling contractors are to continue drilling wells.

Higher crew wages are certainly very much in order, but can only be allowed when the producers are willing to pay for them. For the past several years, drilling contractors have accounted for well over 90 percent of all domestic drilling requirements, and this percentage has been increasing each year. The producing companies, from whom the contractors derive all their revenue, apparently are greatly dependent upon the drilling industry to drill their wells for them. Therefore, producers should be vitally interested in seeing that contractors maintain a strong, healthy position. Producers should be willing to pay a price for drilling that will enable the efficient contractor to keep his experienced labor force on hand, to replace worn machinery when it can no longer be used, and to realize a legitimate profit from his operations.

New tool advances. The drilling industry, service companies and manufacturers have made tremendous advances in the past several years in perfecting new techniques and tools that allow wells to be drilled deeper and faster. The oil industry is indebted to these people for the achievements they have attained.

There is, however, a slowing down point for many of these new developments which are both time consuming and expensive. The bit manufacturers are continually working on new teeth design to cut hole faster. Rig manufacturers are fabricating new pumps, drawworks, drill pipe, etc. that will speed up penetration rates, and shorten trip time. Drilling contractors need to—and should—take advantage of every cost and time saving device, but some of them are most expensive and cannot possibly be paid for at the prevailing drilling prices.

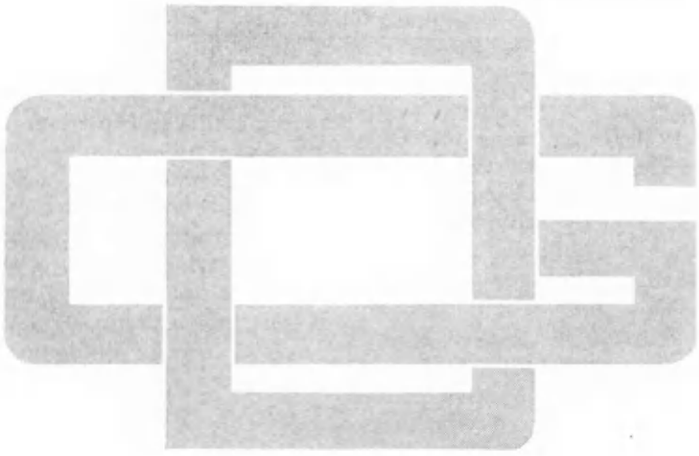
It appears that the producing companies are awakening to the contractors needs and are taking steps to help. When enough producers show interest, the situation will surely change for the better. Perhaps this will be forthcoming next year.

John J. Moran, president, American Association of Oilwell Drilling Contractors, entered the oil industry in Drumwright, Okla., in 1912. He started as a cable tool drilling contractor, principally in Osage County, Oklahoma, in 1918 and later moved to Wichita Falls, Texas, and acquired his first rotary rig in 1924. A year later, he formed the Moran Drilling Company and Moran Bros. Inc. with his brother. The firms operate as a partnership drilling and producing company in and around the Wichita Falls area. Moran was one of the original organizers of AAODC and has been a director of this organization since its first organizational meeting.

GARDNER-DENVER 700 DRAWWORKS

Only Gardner-Denver, with its 100 years' experience in building every type of equipment for the oil field and industry, could have produced the completely new GD-700 drawworks. An eight speed, seven hundred horsepower unit, it is unparalleled in its depth class. The GD-700 design features short shafts that reduce bearing center distances . . . unit engineering of sprockets and chains to reduce wear . . . heavily reinforced side plates for rigid bearing support. Every component has been selected and engineered to produce a balanced drawworks that will operate with speed and low cost maintenance on drilling programs in the 5,000 to 10,000 foot range. □ The drawworks, transmission, controls, compound, engines and pump drives are mounted on a single main skid. When moving, only the auxiliary brake with its skid and the engines need be removed. Throughout the engineering of the GD-700, every drilling problem has been considered to assure the operator of a drawworks that is fast, safe and easy to move. □

The new Gardner-Denver 700 drawworks features: 330° wrap drum brakes □ Eight hoisting speeds and reverse □ Four rotary speeds and reverse □ Air controls for all rig operations □ All friction clutches mounted outboard □ Auxiliary positive Lo drum clutch □ Positive transmission clutches □ Centralized brake lube-center □ Hydromatic brake water level control at console □ Two package moving **GARDNER-DENVER**



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Please turn page.

DRILLING BRIEFS

DRILLING MUD DATA — REPORT 61-2

SOLTEX* Reduces Torque, Drag, and Sticking

When introducing our new mud additive a short time back, we talked mostly of SOLTEX's ability to stabilize hole conditions in sloughing shale . . . improving downhole flow properties and fluid loss control, reducing the need for other chemical treatments, and improving oil emulsions. These and other advantages are continuously studied in the lab and successfully verified in the field.

Early in the game, we also realized that SOLTEX might be a natural for reducing torque or drag, and for helping prevent stuck drill pipe. You can't do much with this in the lab . . . so as soon as field testing began, we started taking notes. Sure enough, in well after well SOLTEX did an amazing job of reducing friction and controlling shale. Considerable savings were made possible because of improved hole conditions which resulted in faster penetration rates, rig time saved, and reduced equipment maintenance. Brief accounts on a few of the wells studied are given below.

Sticking and Dragging in Louisiana

While drilling a deviated hole (20°) in Tensas Parish, Louisiana, the bit hit an obstruction at 6,101 feet and stuck. After working the pipe for 6½ hours with no results, the contractor decided to spot oil. While waiting for the pump truck, a treatment of 2½ lbs/bbl of SOLTEX was made over one circulation. Within minutes after the SOLTEX treated mud reached bottom, the pipe came free. No further trouble was encountered.

At a Louisiana Gulf Coast well, the pipe stuck while drilling at 12,400 feet. Three lbs/bbl of SOLTEX were added to the mud, washover operations were started and the fish was recovered with no difficulty.

At one well in South Louisiana, the hole was 8° off vertical and drag was 50-60,000 lbs at 16,180 feet. Five lbs/bbl of SOLTEX were added to the gyp mud over one circulation and drag was practically eliminated. At 16,330 feet, the hole was still drifting but no further drag was experienced.

At another well in the same area, 5 lbs/bbl of SOLTEX were added to control a troublesome shale section which was making it hard to set a whipstock at 7,300 feet. Drag was reduced to less than 10,000 lbs. Three whipstocks were successfully set and hole deviated 30°. The gyp mud used weighed 12.2 lbs/gal.

Tight Hole in West Texas

At 11,780 feet, the hole was off 7½° and drag was 20,000 lbs while pulling off bottom. Slightly over one lb/bbl of SOLTEX was added to a low solids Driscose* mud (11.7 lbs/gal). Torque was reduced and, on the first trip out, drag went down 50%. On previous trips, there appeared to be about 40 feet of fill-up. On the trip after SOLTEX was added, there was none. It is believed that this "fill" was actually friction causing the drill stem to take weight.

Reduce Torque 50% in Oklahoma

At 13,784 feet, 2 lbs/bbl of SOLTEX were added to a 12.8 lbs/gal mud to help stabilize hole conditions. Torque was reduced 50% after the first circulation. Flow properties of the mud improved, pump pressure decreased, and penetration rate improved. A maintenance treatment of 100 lbs of SOLTEX was used on this well during each tour until setting liner at 14,260 feet.

Excessive Friction in California

This well had been sidetracked at 10,000 feet, and hole deviated 23°. Friction had become progressively worse making it necessary to drill in and out of the hole. Approximately 2½ lbs/bbl of SOLTEX were added to the sodium base mud and conditions improved immediately. Treatment was continued as maintenance to final depth and no further trouble was encountered.

• • •

Excessive torque or drag is only one step away from being stuck. Preventative treatments of SOLTEX at the first sign of drag buildup is almost a sure cure that more and more operators are adopting. SOLTEX is usually added in concentrations of from 2 to 6 lbs/bbl, depending upon hole conditions. For more complete information on SOLTEX . . . contact your mud dealer or Drilling Specialties Company representative.

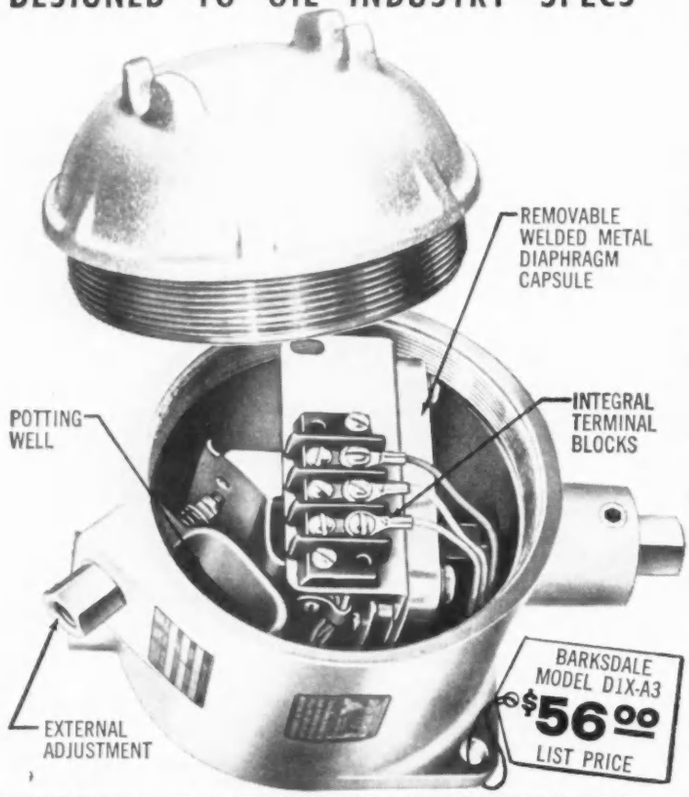
*SOLTEX and Driscose are trademarks for drilling mud additives.

DRILLING SPECIALTIES COMPANY
Bartlesville, Oklahoma

INSTRUMENT ACCURACY (± ½ PERCENT)

EXPLOSION PROOF PRESSURE SWITCH

DESIGNED TO OIL INDUSTRY SPECS



WE BUILD IN	WE DON'T USE
EXTREME ACCURACY and DEPENDABILITY maintained during operating life due to direct acting design	LINKAGES & BEARINGS which, as they wear, make the setting of the pressure switch drift.
OPERATION IN ANY POSITION which saves the installation costs encountered in mounting a switch that uses liquid switching elements	LIQUID SWITCHING ELEMENTS which make the switch difficult to mount and very critical to vibration.
IMMUNITY TO VIBRATION you can mount the switch directly on your vibrating or moving equipment.	ACCORDION BELLOWS which make the pressure switch sensitive to vibration.

PRESSURE SWITCH DIVISION

ASK FOR HANDBOOK & CATALOG 61-62

Barksdale valves

5125 Alcoa Avenue, Los Angeles 58, California

Improved design, reduced prices

New Barksdale diaphragm pressure switches incorporate the improvements most frequently requested in personal consultations with leading production men in the petroleum and other major industries before designing was begun. Improved switch accuracy, higher proof pressures, and important installation and servicing economies are direct results reflected in Barksdale explosion proof models. Employment of the erector set principle of construction (compact basic diaphragm unit with optional housings) permits production savings that make possible substantially lower prices.

Instrument accuracy of ± ½ percent

Accuracy of ±½% as compared to the customary ±1% is guaranteed, and each unit is tested for repeat accuracy of set point and re-set point before shipment.

Proof pressures to 300 psi

In the low settings Barksdale explosion proof pressure switches will actuate at 0.1" mercury with proof pressure to 10 psi. In higher ranges they will go up to 300 psi proof pressure at settings to 150 psi.

Removable diaphragms

As diaphragms may be removed, substitutions can be made readily to accommodate varying pressure requirements or to install diaphragms of different metals as fluid characteristics may demand. This exchangeable feature is important when servicing for paraffin accumulation as field personnel need carry only the diaphragms (not entire switches). Integral terminal blocks facilitate removal of switches in making diaphragm substitutions.

External adjustment

Explosion proof switches (single setting or dual control) may be adjusted externally. Recessed screwdriver adjustment openings are made tamperproof by insertion of threaded safety plugs.

Additional Barksdale features

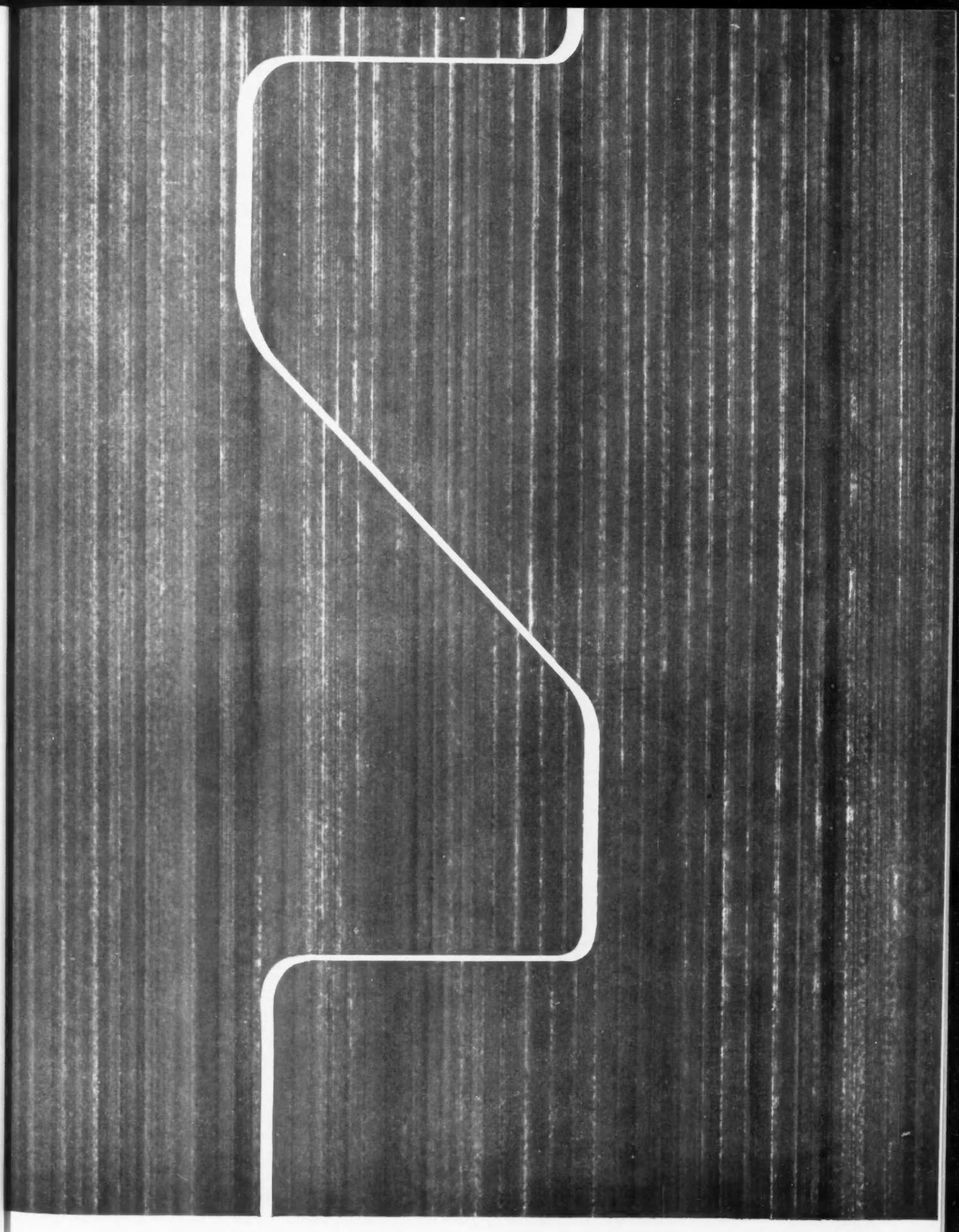
Pottable electric outlets.

Housings are independent of the sensing and switching mechanisms. Ambient temperature will not throw switches out of adjustment.

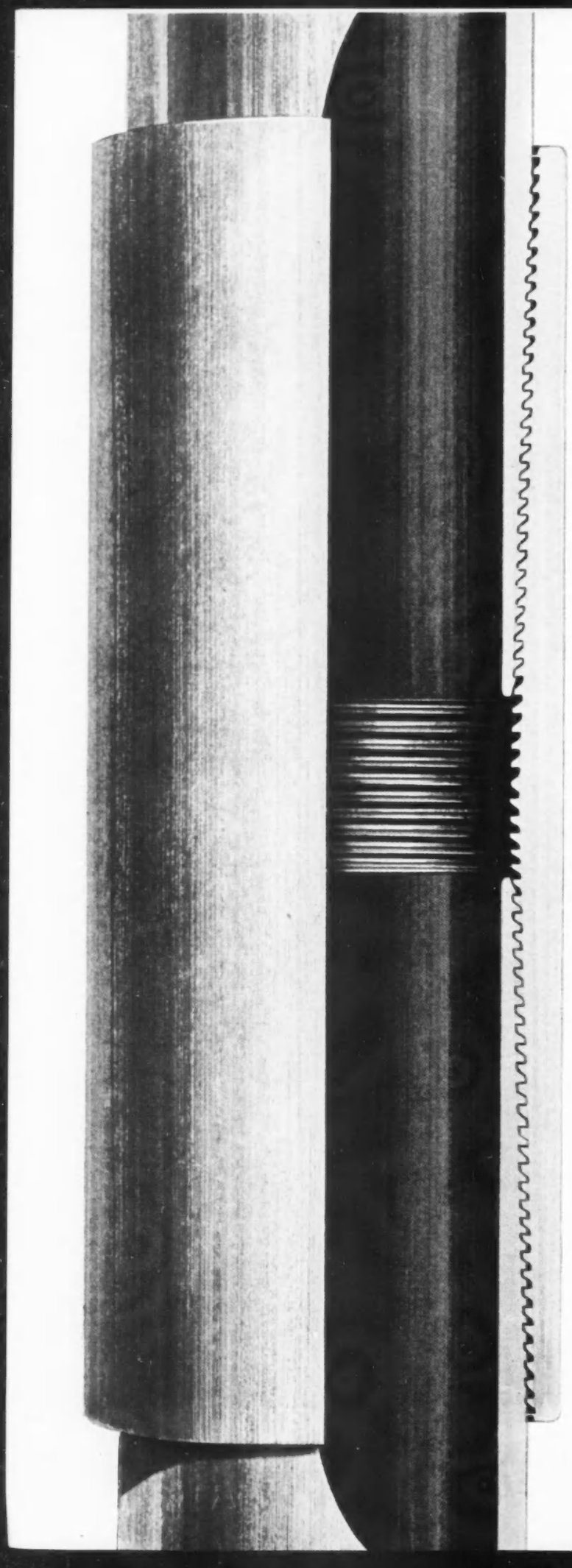
Servicing instructions are on the inside of housing cover to allow for painting of the units.

Ask for Handbook and Catalog 61-62

Complete details on Barksdale diaphragm, piston, and bourdon tube pressure switches are included in a new handbook and catalog. This free book is a practical aid in planning the vital link between your electric and hydraulic circuits. It contains a glossary of terms, a schematic demonstration of operating characteristics, and a suggested step-by-step procedure for simplifying pressure switch selection. In addition, there is a complete run-down on all the detail features leading to the unit that answers your specific control problems. Write for Handbook and Catalog 61-62, or ask your Barksdale representative.



This advanced thread design cuts pipe costs...



Until recently, oil country casing and tubing had utilized upset ends to strengthen the joint for deeper wells. But this joint thickening meant a loss of valuable space within the casing—space that's more important than ever with the trend toward more multiple completion wells and slim hole wells.

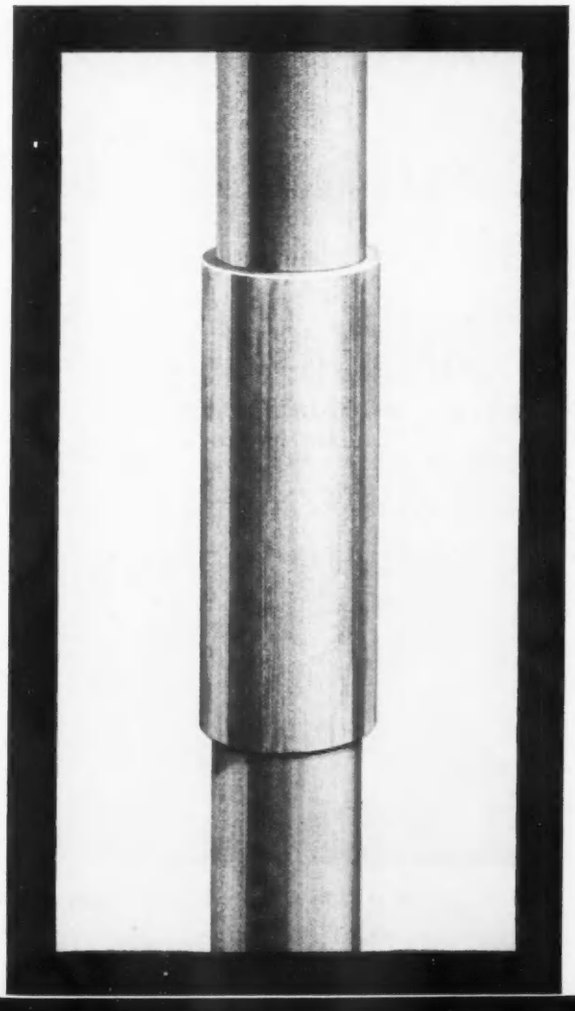
National Tube has developed a non-upset joint—the cost-saving USS National Buttress-Thread joint. The unique run-out design and flank angle of the Buttress-Thread gives pipe all the strength it needs. In fact, the joint strength is comparable to that of the body of the pipe. The Buttress-Thread eliminates the need for the internal upset in casing, as well as the external upset in tubing. Now there's maximum hole clearance, and multiple tubing strings can be run with minimum interference.

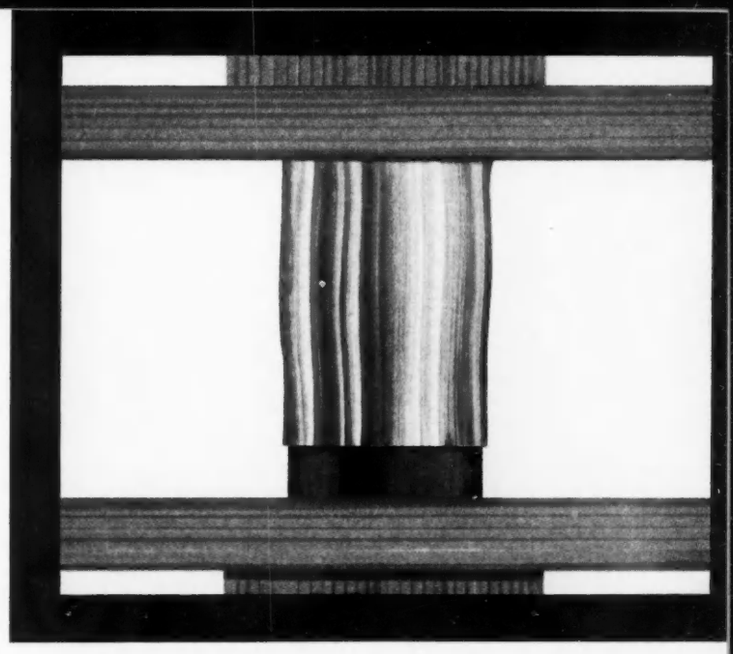
To prove the exceptional strength of the Buttress-Thread casing joint, National Tube engineers drove pipe nipples into the coupling until the threads tore loose. Despite this brutal pounding, the coupling did not

fail—the joint remained intact.

The latest adaptation of the Buttress-Thread is to oil well tubing. USS National Buttress-Thread tubing can be readily stabbed firmly into a coupling without thread damage or cross threading. Mill tests show joints can be made up and broken at least 12 times without thread damage or impairment to joint performance. Make-up time is faster because the pipe slips easily into the coupling, and engages immediately. Then 2½ turns make the joint gas-tight.

The coupling threads are





heavily tin-plated so gas won't leak even at pressures of 15,000 psi. You get more use out of Buttress-Thread tubing because, unlike upset pipe, if ends are damaged, they can be repaired by cutting new threads right in the field. For more information on casing or tubing with the Buttress-Thread, call or write National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Penna.

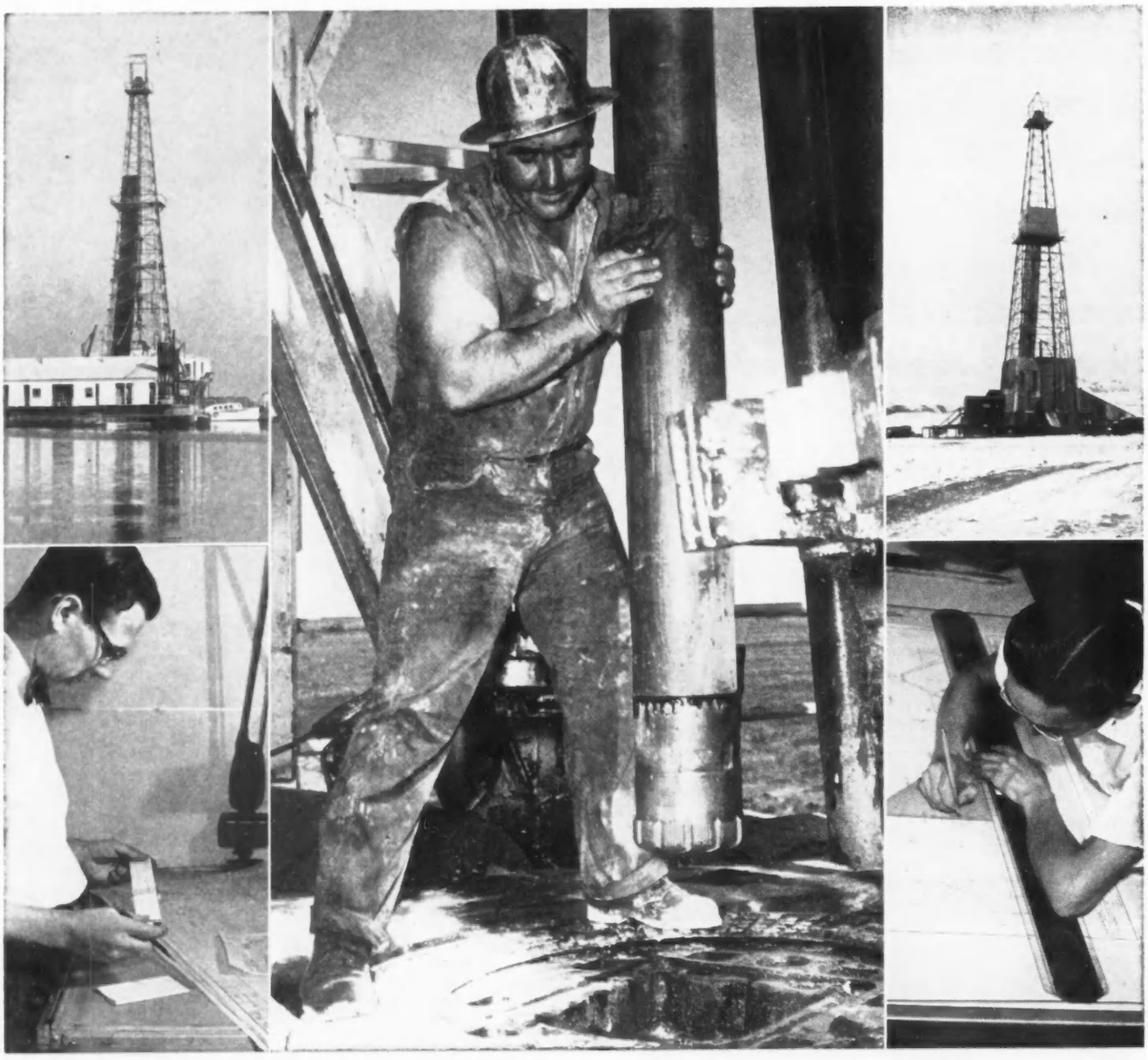
USS and National are registered trademarks

USS

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

This mark tells you a product is made of modern, dependable Steel.



Operate at "Less cost per foot"

With manufacturing plants throughout the world Christensen can design and deliver your "engineered" diamond bit, on time, regardless of your job location.

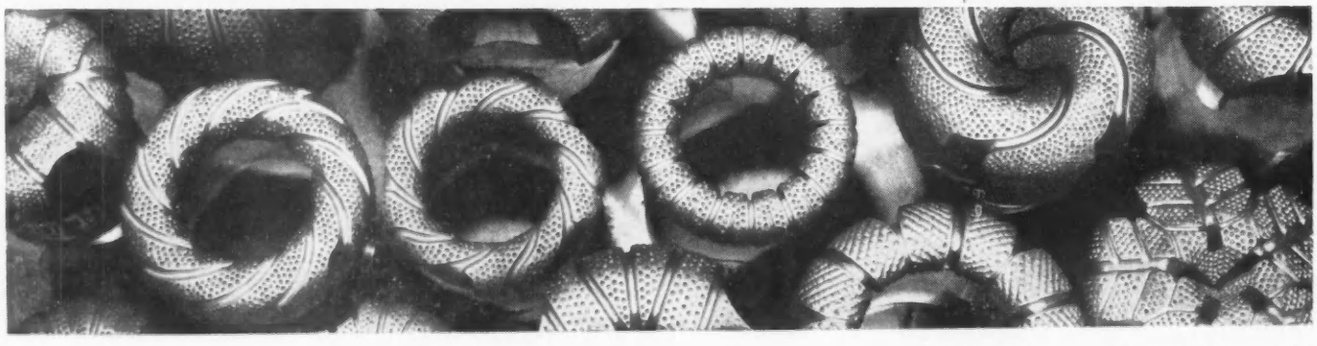
"Less cost per foot"

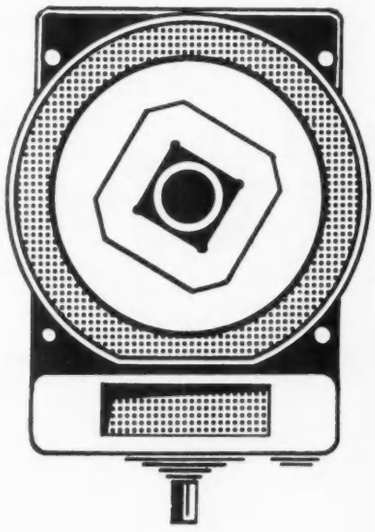
CHRISTENSEN DIAMOND PRODUCTS

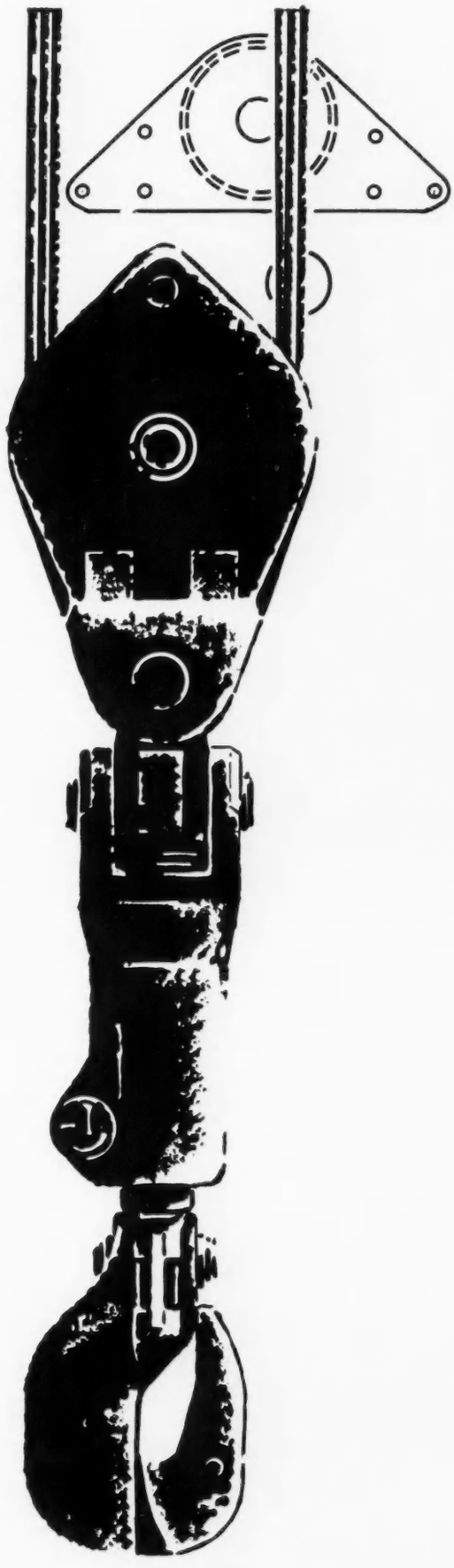
MAIN OFFICE AND PLANT 1937 SOUTH 2nd WEST

SALT LAKE CITY, UTAH

SERVICE FROM WORLD-WIDE SALES OFFICES AND MANUFACTURING PLANTS







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ROTARY OIL WELL DRILLING EQUIPMENT

For more than 25 years we have developed and built rotary deep-well drilling rigs. Our rigs feature economic, quiet and reliable operation and are built on the unit construction principle. They are suitable for a variety of geological con ditions. Since almost all components used in the plant have been dimensioned according to API standards they also fit plants using conventional chain drives. Crown blocks, travelling blocks, rotary tables, gear type winches for installations from 6000 to 18000 ft.

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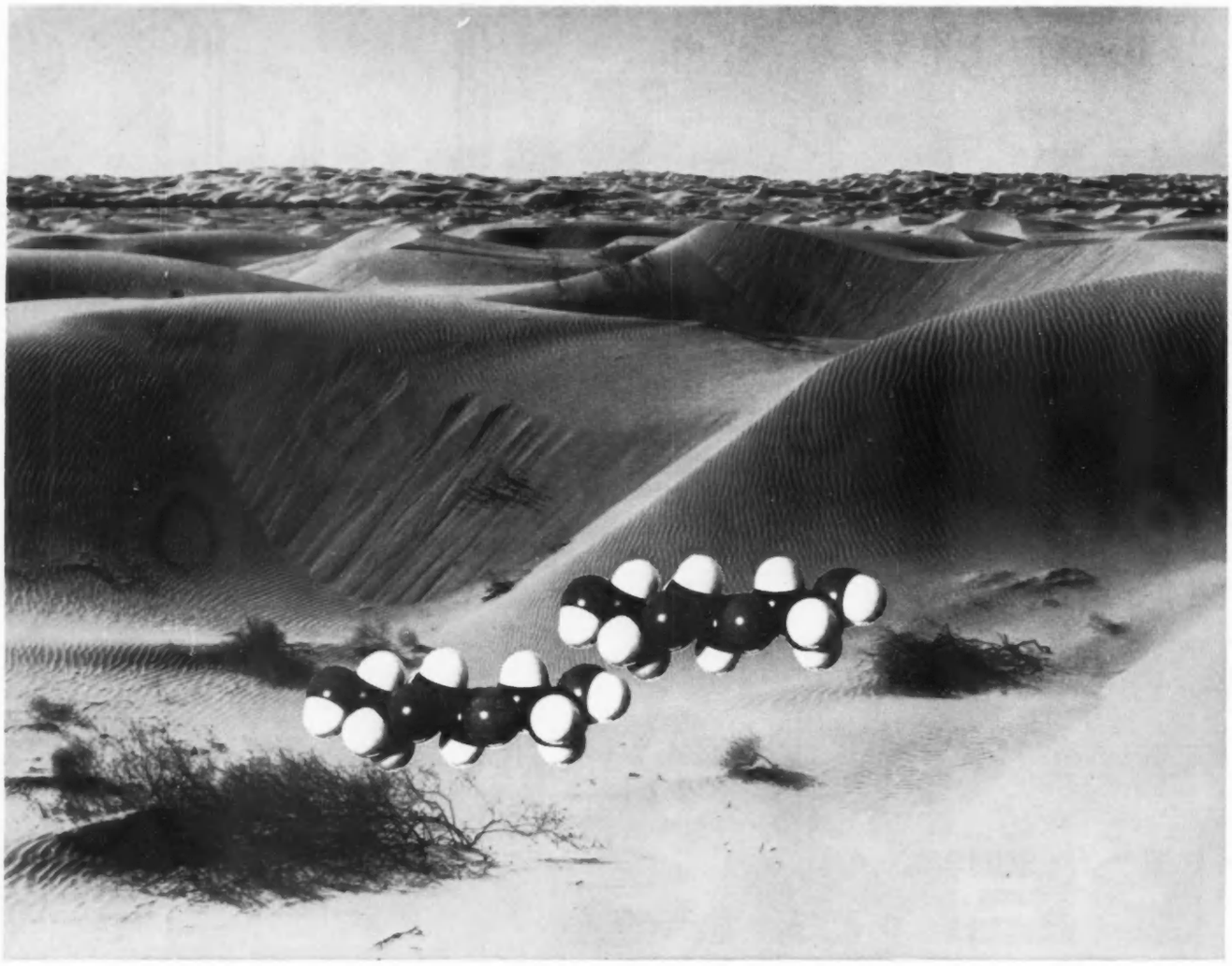
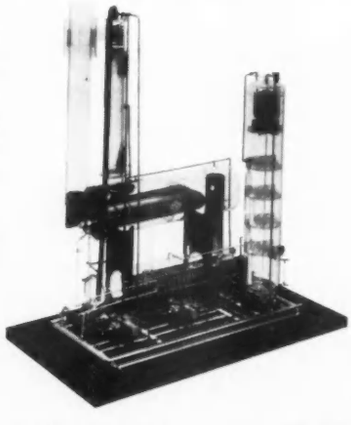


THIRSTY MOLECULES These are molecules of triethylene glycol (TEG), the liquid desiccant widely used in Glycol Dehydration Units for dehydrating natural gas to pipeline specifications or for further processing. When fairly dry (that is, in concentrations better than 98% by weight) TEG becomes exceptionally thirsty and is eager to absorb water vapor from gas by contact. However, like animals and people, TEG becomes increasingly thirsty the dryer it is. Therefore, the dewpoint depression possible with a glycol dehydration system is mainly dependent on the efficiency of the glycol regenerator in drying out (reconcentrating) the glycol after it has picked up water through its contact with the gas stream in the absorber.

Parkersburg SUPER-DRYER* Glycol Dehydrators achieve TEG reconcentration of better than 99.8% by weight without excessive reboiler temperature. This makes possible dewpoint depression of **115°F and higher** with inlet gas temperatures to 140°F without any appreciable increase in operating costs!



Ask for our new brochure on Parkersburg Glycol Dehydrators and a supply of our data sheets for sizing them.

Parkersburg

Division of Parkersburg-Aetna Corp.

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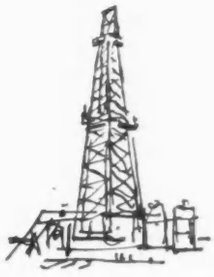
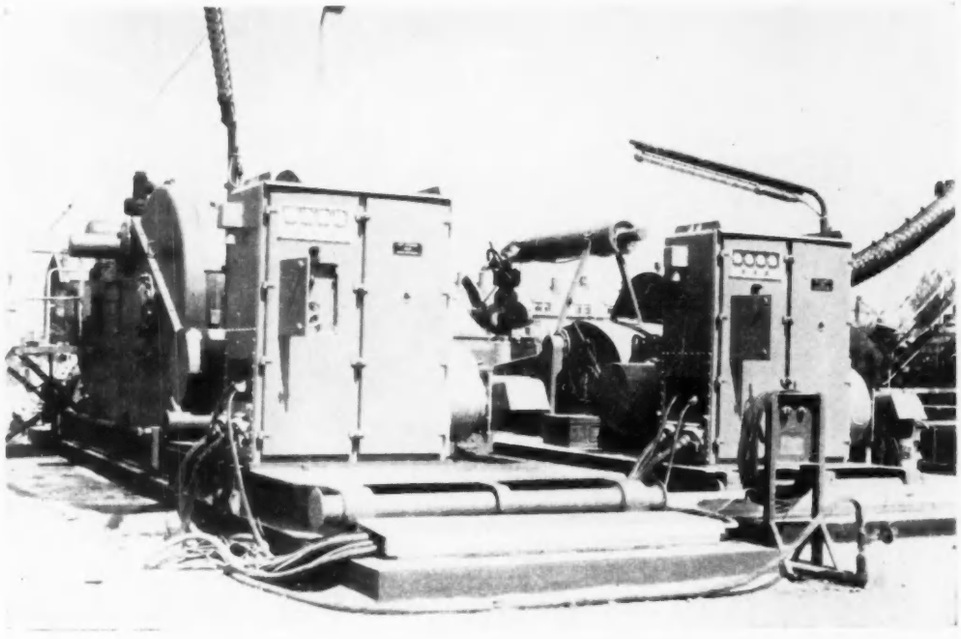
*PARKERSBURG Trademark Patent Pending

D.C. diesel-electric rig drive with SMIT-RING system





In the 'SMIT-RING' system, the principle of the constant-current system has been adapted especially to the many requirements of rotary drilling, which we may list as follows:

minimum

number of spare units required
number of machine types
controlgear
machinery directly on rig

maximum

availability of power installed
fire prevention
safety from electrical hazards
portability
controllability on speeds and cable loads
simplicity for operator

SMIT SLIKKERVEER

N.V. ELECTROTECHNISCHE INDUSTRIE V/H WILLEM SMIT & CO SLIKKERVEER HOLLAND

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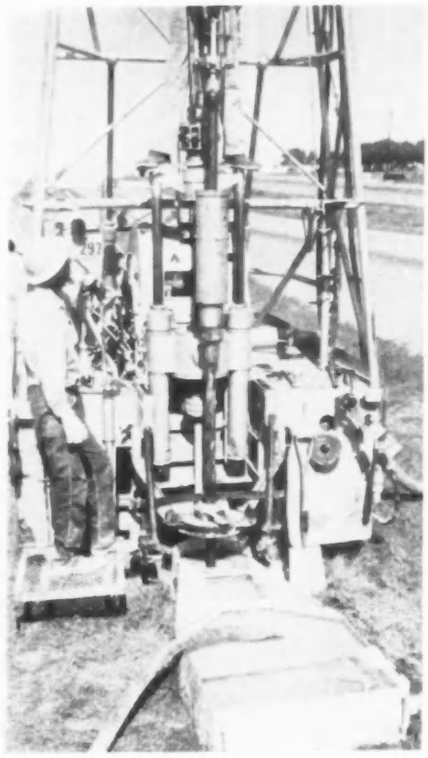


Practical operating hints

These ***How-To-Do-It*** *ideas can save you money*

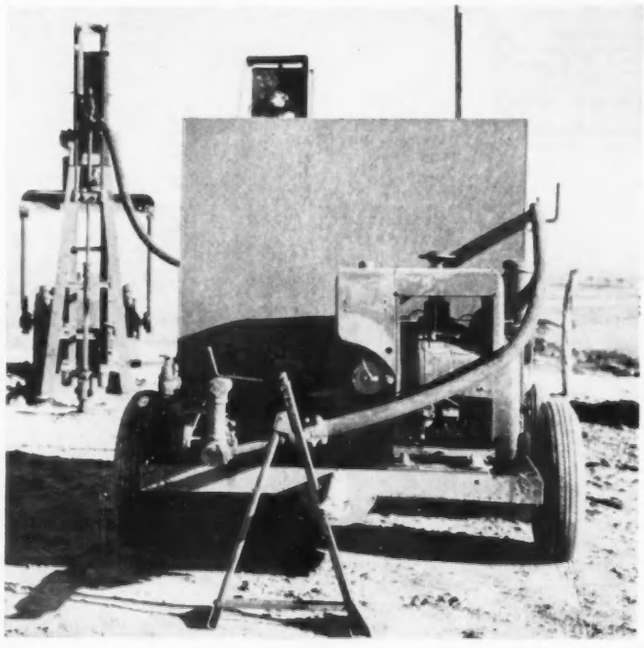
Mud Tank Connected to Conductor Pipe Speeds Core Hole Drilling

When shot holes for seismograph work and core holes for surface geology are necessary, a simple way to handle the mud returns is to construct a mud tank onto the conductor pipe. The mud tank is made of ¼-inch steel plate, cut and welded as shown. The mud returns to the tank and recirculated, after the cuttings have settled out, through the mud pump and back through the hole. The clean mud together with the make-up water is taken out at the front of the box. This hook-up makes for a clean mud free area around the hole site.

Portable Well Test Unit Reduces Storage Needs

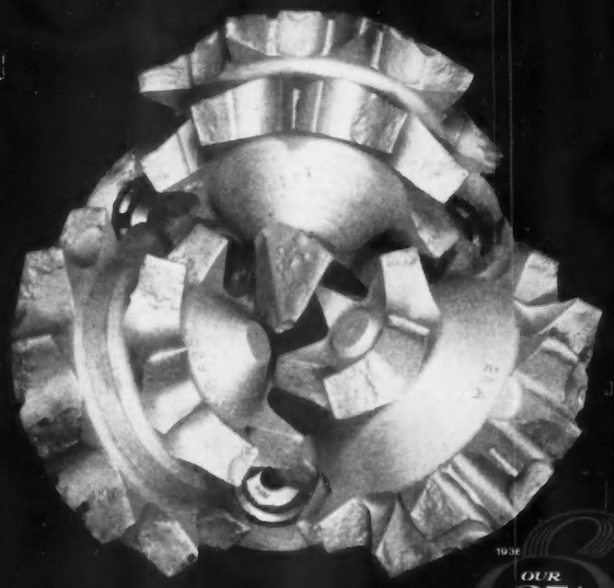
Use of a trailer-mounted test unit can reduce tank battery storage requirements, since no test facilities are necessary at individual batteries.

As shown at left, the unit is connected into the flow line by a rubber hose. Production is indicated on the float actuated meter mounted on top of the unit. Upon completion of the test, a small pump (see photo at right) is used to discharge oil from the tank into the flow line.



DT

Designed for Soft Formations



SMITH TYPE DT 3-cutter rock bits are designed and constructed to insure rapid rates of penetration in moderately soft to soft formations . . . sturdy, deeply cut and widely-spaced teeth . . . optimum self-cleaning properties are provided by the widely-spaced teeth in combination with ample tooth deletions and efficient flushing action of the circulating fluid.

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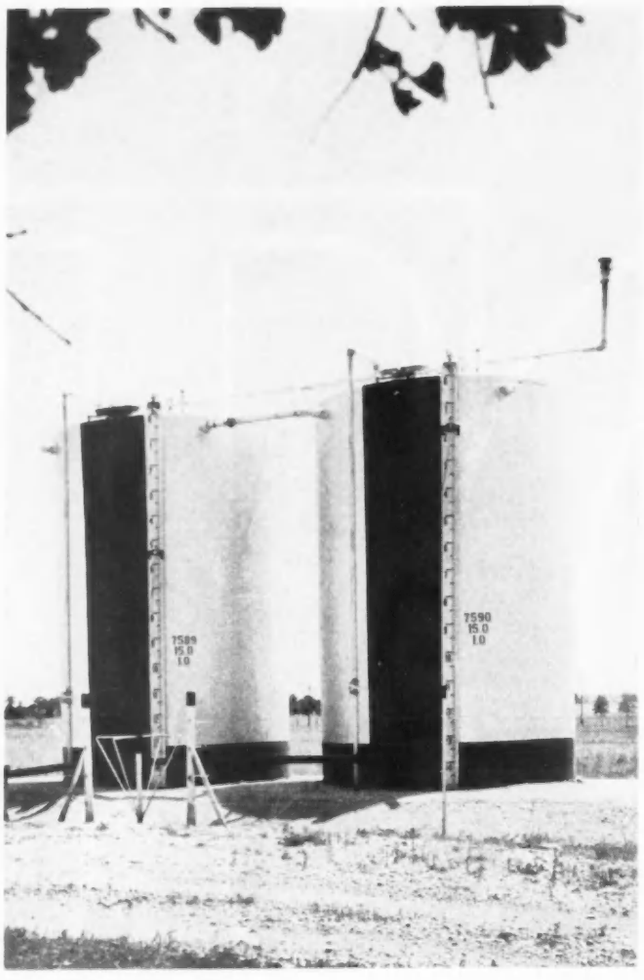
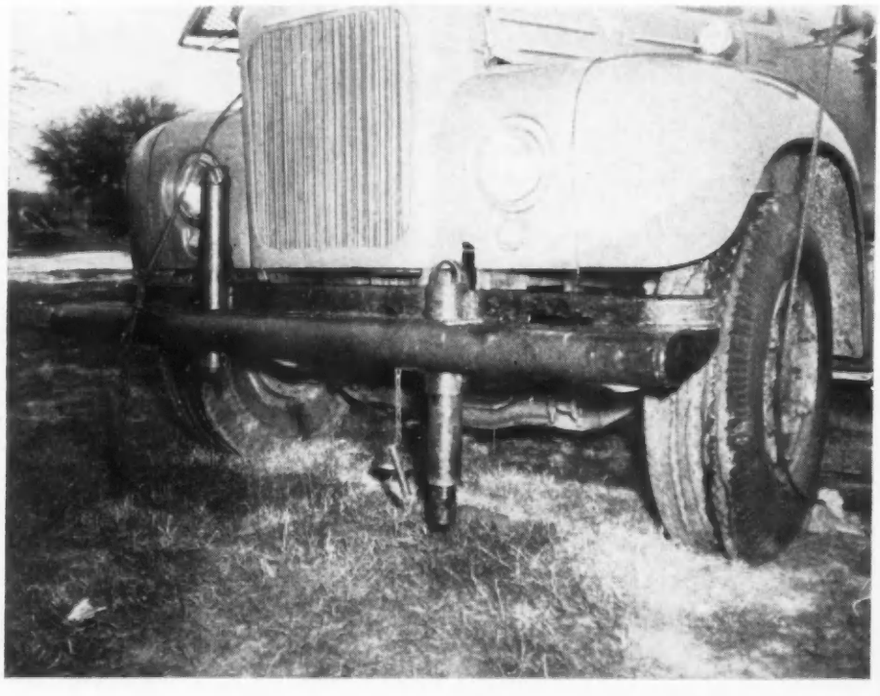


Outside Tank Gages Save Pumper's Time

Installation of calibrated scales on the outside of each stock tank shortens pumper's gaging time and increases the area that can be covered by one man in a single day. Gages can be taken from the road by simply observing the reading on the float actuated scales. Since personnel do not have to climb stairs to the catwalk and gage each tank individually with a hand line, the time required for such a procedure multiplied by the number of tank batteries worked is saved each day if batteries are equipped as shown.

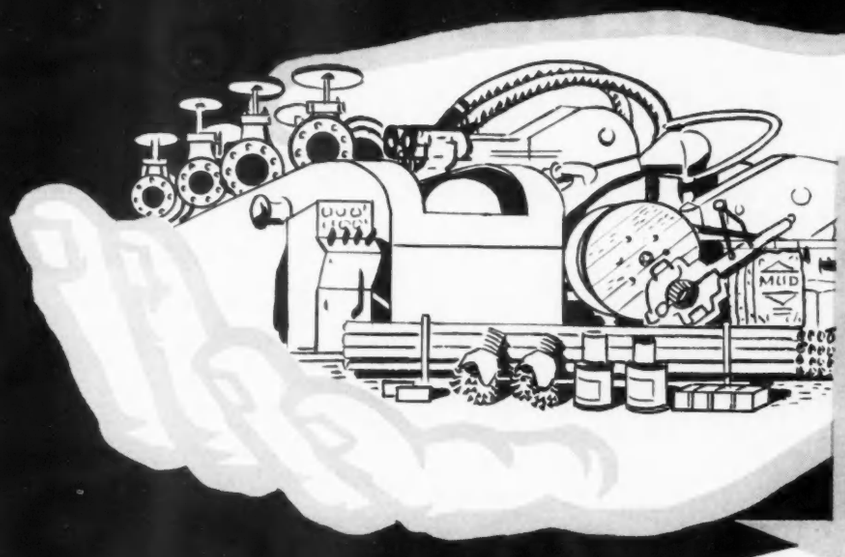
Collapsible Jack Supports Front of Well Servicing Unit

A simple means of stabilizing the front of a well servicing unit will double as a grill guard when the unit is on the road. The one on the left is shown in the over-the-road position and the one on the right is ready for screwing down onto a stand to steady the rig. They are installed by cutting out a hole in the bumper and welding on a collar of pipe a size larger than the support pipe. The collar protrudes a few inches below the bumper so that a hole can be drilled. This hole matches two holes in the support which holds the support in the raised or lowered position. When it is in the lowered position, it clears the end of the jack on the inside and when it is in the raised position, the pin goes through the hole in the lower end of the jack to keep it from vibrating out. A bail located on the top of the assembly makes it easy to raise and lower.



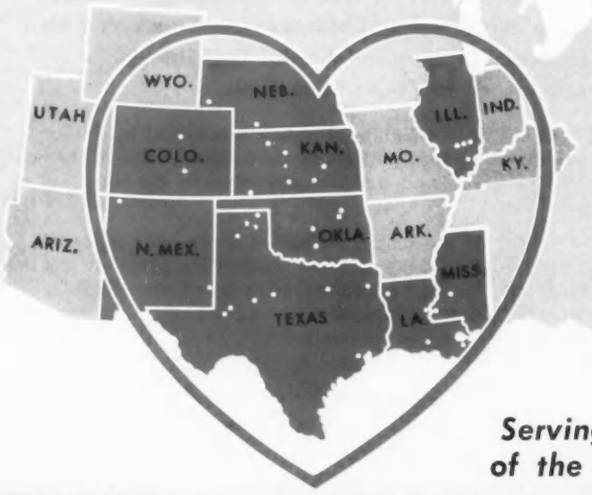
Bigger Stocks

SUPPLY BOVAIRD COMPANY



ON HAND NEAR *well* YOUR ~~DOOR~~ STEP

SAVE YOU TIME



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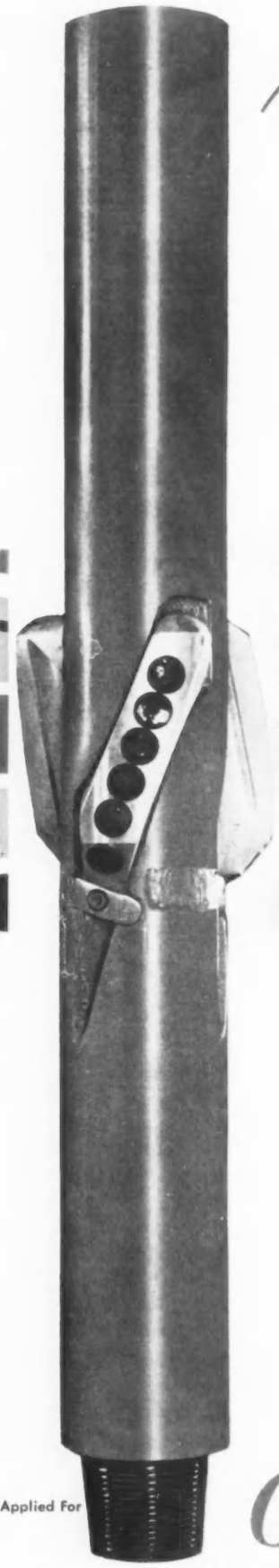
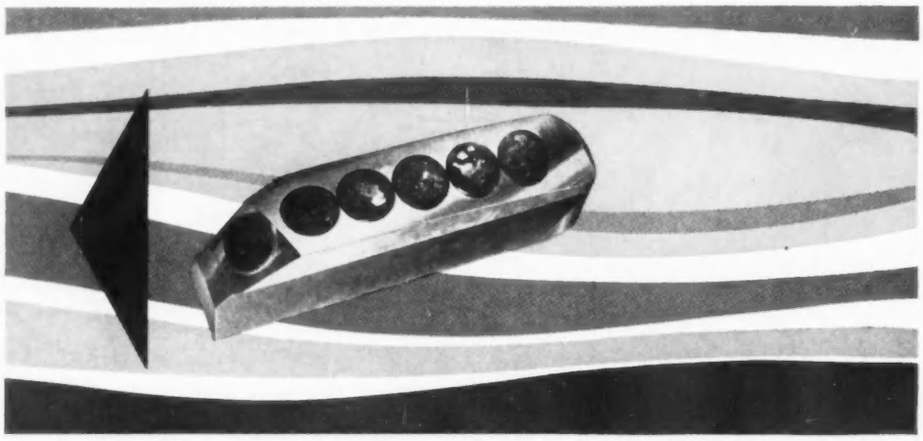


New Safety... New Economy...

from GRANT in the BUTTON DRILBLADE STABILIZER!

Now—to the *economy* of drill string stabilization with Grant detachable blade stabilizers—you can add *greater safety than ever before.*



Grant's entirely new concept in blade design is this all-new Button Drilblade* of forged and heat-treated aluminum with press-fitted, individually hard-faced, mild steel inserts. ***It cannot break off or come loose in the hole.***

Longer downhole life of the all-new Button Drilblade is achieved by thicker application of tungsten carbide, made possible by the cupped design of the insert heads. Also, a new type of rod delivers a higher percentage of the hard metal to the bearing surface.

Tensile strength and density of the forged aluminum blade body is further strengthened by the press-fitted steel inserts. Thus, neither the blade nor the inserts can work loose or break off. Yet the blades are easily washed over. Drilblades are retained in the Stabilizer body by tapered slots, engineered so that the blade is actually tightened during use, and by Double-Safety Lock Plates. Removal of Lock Plates permits the blades to be easily changed on the rig floor.

The Grant Drilblade Stabilizer—already the preferred tool for directional drilling all over the world—is now the most dependable tool available for this work.

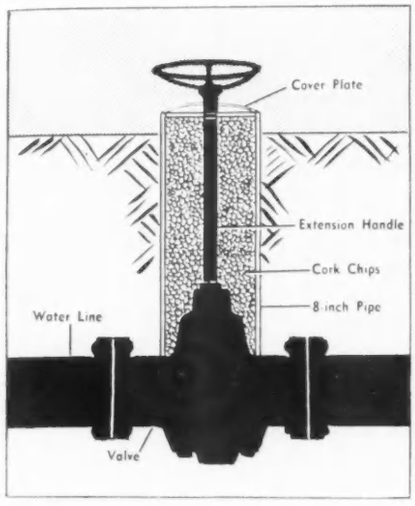
The new Button Drilblade is fully interchangeable with Grant standard blades. It is available in all body sizes 'round-the-clock from your Grant service man—or write Grant direct for specifications and prices.

*Patent Applied For

GRANT OIL TOOL COMPANY

2042 EAST VERNON AVENUE, LOS ANGELES 58, CALIFORNIA · Cable Address: GRANTOOL

DISTRICT OFFICES AND WAREHOUSES: *Bakersfield, Compton, Ventura, Woodland, Calif. • Liberal, Kan. • Harvey, Houma, Lafayette, La. • Laurel, Miss. • Farmington, Hobbs, N. M. • New York, N. Y. • Ardmore, Oklahoma City, Okla. Corpus Christi, Houston, Kilgore, Odessa, Tex. • Casper, Wyo. • Edmonton, Pincher Creek, Ft. Nelson, Canada Representatives in Argentina, Brazil, France, Italy, Middle East, Mexico, Venezuela*



Cork Chips Prevent Valve From Freezing

By filling the annular space between the extension handle and the valve box with cork chips, one company minimized the danger of water lines freezing in sub-zero weather. The water line, shown schematically here, was below the frost line and was safe from freezing except at the valve box. The latter is an eight-inch pipe running from the valve to the surface of the ground.

To eliminate this hazard, a circular cover plate, hinged for easy access, was mounted on top of the box. The space below it was filled with the light cork chips. The chips provide sufficient insulation for the valve, and when necessary, they are easy to remove.

Laying Down Drill Pipe Made Easier

A joint of used drill pipe is modified to fabricate a device for laying down drill pipe. The drill pipe is cut in two, resulting in two halves. One half is welded to vertical members which are welded and reinforced to a skid base.

When installed on the cat walk, the upper piece slides up to the derrick floor so that the pipe can be set into the slot (as shown) and fastened into place. A spring is placed in the coupling shown in the front. The lower portion will rotate causing the drill pipe after it has slid down the groove to fall out and onto two members of pipe used as ramp to the pipe racks. A cat line is tied to the handle and will rotate the drill pipe onto the rack after it has slid down the groove. This operation may be accomplished from the derrick floor and not by an added man on the catwalk. This will relieve this man who is normally needed for other operations.

5 months of sand production fail to damage

CAMCO

Straight-Thru Design

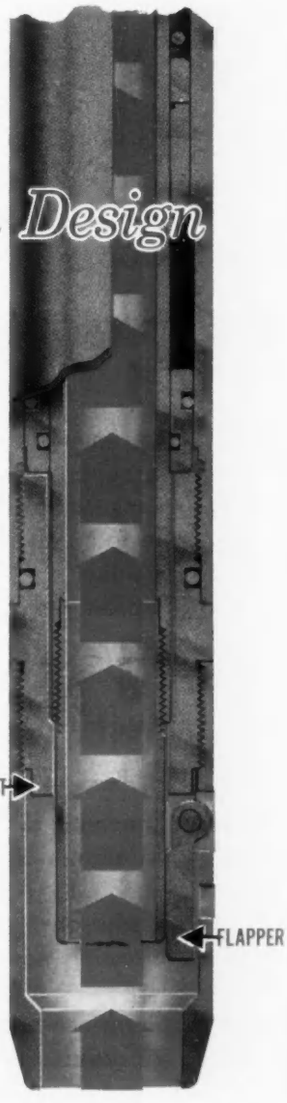
A2 Tubing Safety Valve

In a South Louisiana well, heavy sand production had repeatedly cut out subsurface tubing safety valves of conventional design, necessitating replacement every 60 days.

Then a Camco *Straight-Thru* design A2 Safety Valve was installed. By its large straight bore and by location of the flapper and flapper seat outside the flow stream, *Straight-Thru* design reduces flow turbulence and protects vital seating surfaces against sand cutting. Pulled from the sand-producing well five months after installation, the Camco A2 Safety Valve was found to be in perfect condition—ready for further duty!

Constant operating readiness for long periods of service makes the Camco *Straight-Thru* A2 your most reliable, positive assurance of automatic shut-in if surface controls should fail.

For your copy of Camco's new 28-page A2 Safety Valve Brochure, call your Camco representative or write



Straight-Thru design reduces turbulence, protects valve seating surfaces against abrasion, assures proper closure of valve at predetermined pressure drop.

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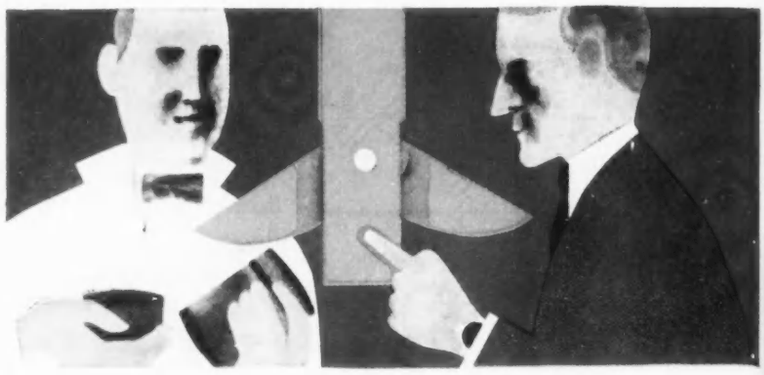
UNDERGROUND SUPERHIGHWAY



Read how Gulf's Single-Point Entry Technique for fracturing gives up to 100 times the fracture capacity of conventional fracturing... offers you precision placement and increased drainage, too.

GULF

Perhaps you have used hydraulic fracturing successfully. It has helped many oilmen jump well production to 5 and 6 times the usual bbls./day.

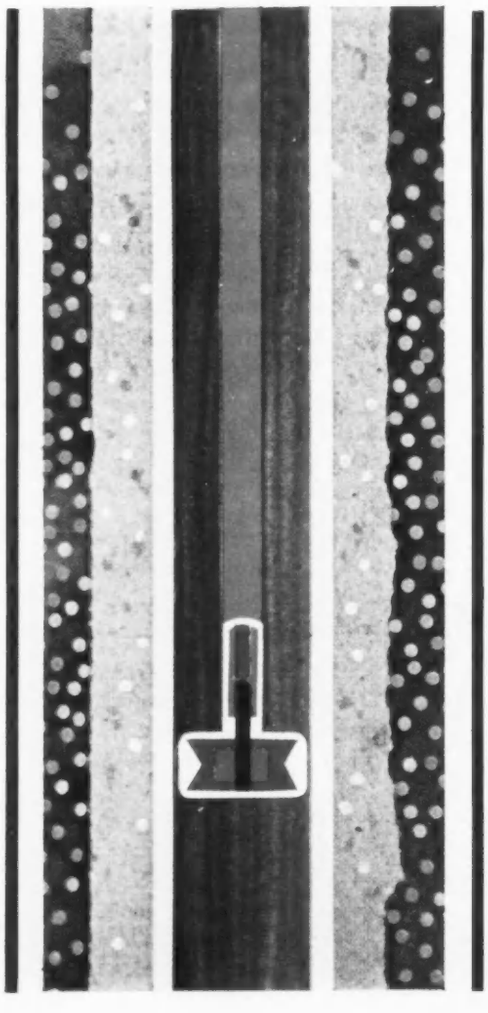
For a dozen years now, the basic technique of pumping fracturing fluids down the well bore under pressure to stimulate the flow of oil has been modified and improved.

But this conventional fracturing has its limitations. The industry has known this for a long time. At best, it is hit-or-miss. You can end up throwing several thousand dollars down a hole.

More often than not, you may be limiting your profits when your pay zone is thick or of low permeability.

It's also true that fracturing can give you disappointing results in a thin zone if the location of the fractures isn't right.

The scientific answer. Now, out of studies of fracturing at the Gulf Oil Corporation's Harmarville Research Center, comes an altogether new approach. One that all but takes the "miss" out of well stimulation.



For Gulf's development isn't just another technique. It is a precision system for fracturing. It replaces great gaps in our knowledge of fracturing with a painstakingly developed and tested body of scientific facts. It brings new ideas, new tools into play.

Our name for this precision system is Single-Point Entry Technique for fracturing.

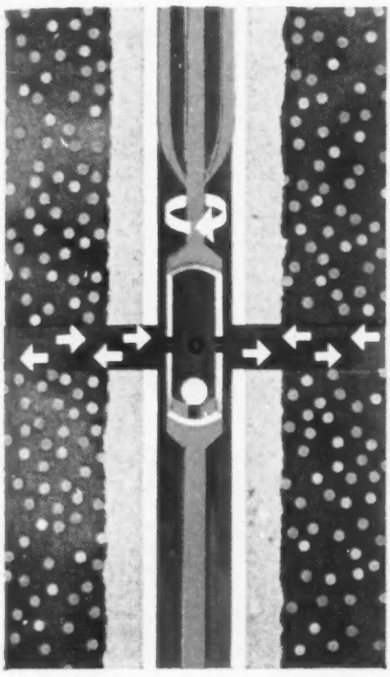
Up to 100 times the fracture capacity. Twenty-four service companies have already become Gulf licensees. In their hands, Single-Point Entry Technique for fracturing has already proved itself to be all our studies showed — and more.

One, it stimulates wells on jobs where conventional fracturing wouldn't even be worth a try. In itself, this characteristic moves

fracturing a long step ahead.

Two, Single-Point Entry Technique for fracturing usually outstimulates conventional fracturing techniques.

In both cases, Gulf's new system gives up to 100 times the fracture capacity of conventional fracturing. It has actually pushed productivity beyond the most hopeful expectations. In some cases, 20, 40, 60 times.



This system gives you all 3. Why does Gulf's new system give so much more than conventional fracturing? Because no conventional technique offers this scientific, systematic, 3-step approach: (1) precision fracture placement, (2) high fracture capacity and (3) an adequate reservoir drainage system.

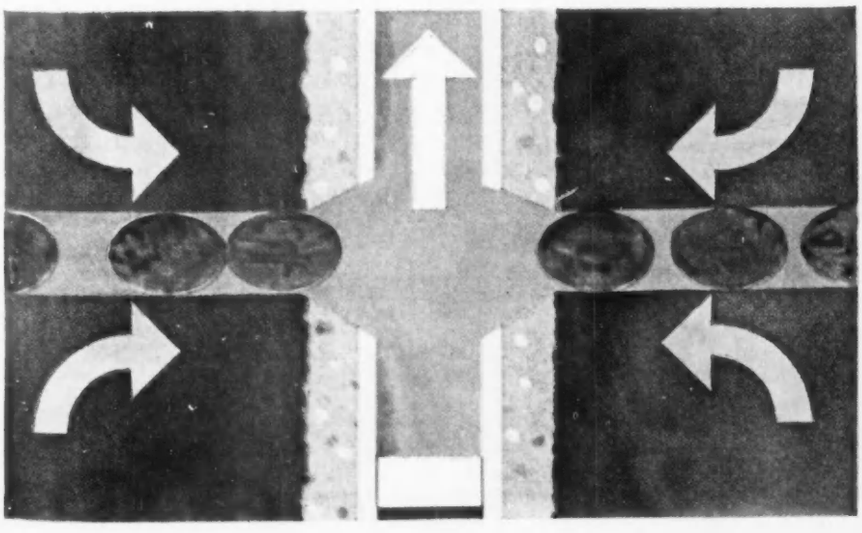
Now Single-Point Entry Technique for fracturing is available to boost your well flow levels. To pay you a sizeable number of bonus benefits as well. To improve reservoir drainage, for one. To lessen pressure drawdown. To lower gas-oil ratios. To minimize water coning. To make work-overs simpler.

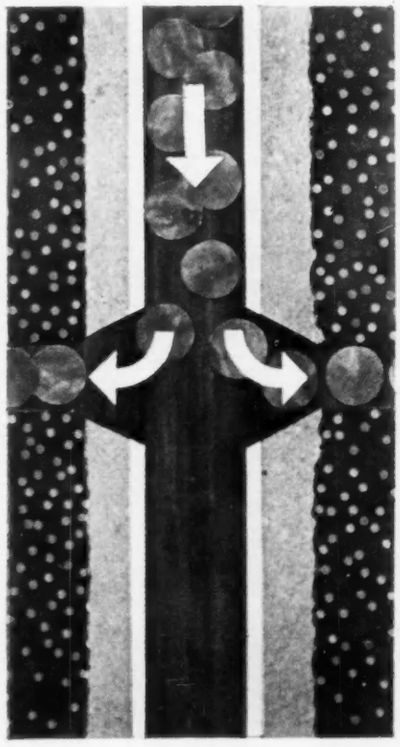
"Superhighway" for oil. No more hope-for-the-best fracture location. In Single-Point Entry Technique for fracturing, any one of three tools cuts the notch precisely where reservoir study says it should.

These tools include a mechanical cutter, a hydraulic notcher which jets an abrasive stream, and a ring charge for use in explosive notching.

No more helter-skelter fractures with Single-Point Entry Technique for fracturing. In their place, a single large "superhighway," extended deep into your pay zone.

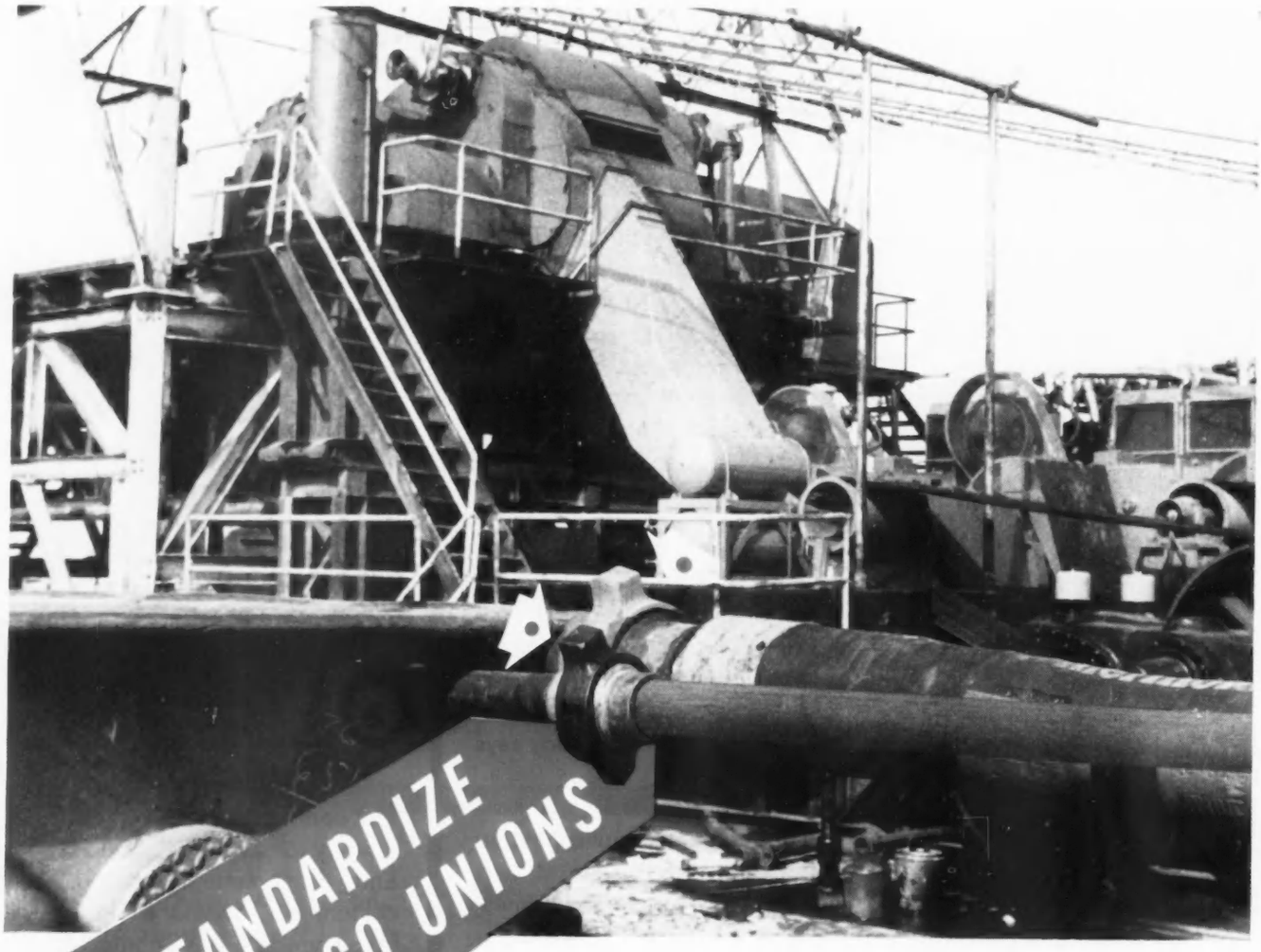
And no more inadequate drainage. Your large fracture area and carefully prescribed propping agents assure that.





Just contact these licensees. It's so easy to have the Single-Point Entry Technique for fracturing custom-fitted to your well-stimulation needs. Simply contact any one of these Gulf licensees:

Acid Engineers, Inc. • Acme Tool, Incorporated • Axelson-Garrett Division, U. S. Industries, Inc. • Baash-Ross Division, Joy Manufacturing Company • Baker Oil Tools, Inc. • BJ Service, Inc. • Cardinal Chemical, Inc. • Chemical Sand Services, Inc. • Dowell Division, The Dow Chemical Company • Eline Acid Company (The) • Eskimo Fracturing & Well Servicing Ltd. • GO Oil Well Services, Inc. • GO-Western Service • Grant Oil Tool Company • Halliburton Company • Independent Oil Well Frac Company • Lane-Wells Company • Oklahoma Fracturing Services, Inc. • Producers Chemical Company • Sand Survey, Inc. • Servco Company (The) • Western Company (The) • Wireline, Inc. • Worth Well Surveys, Inc.



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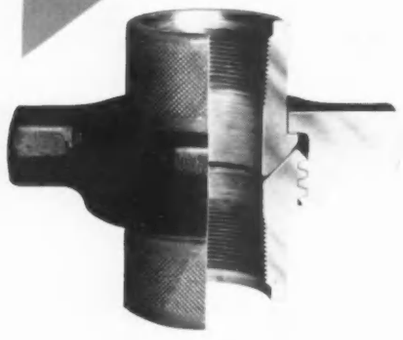

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The complete line of WECO Unions includes sizes 1" through 12", pressure ratings 1000 psi through 15,000 psi.

cut rig-up and rig-down costs . . .

increase operating and maintenance efficiency

The advantages of standardizing with WECO Unions on your drilling rig are numerous and valuable. Piping make-up and break-out time is reduced to a minimum . . . manifolds and many pipe assemblies can be moved intact . . . valves and other fittings can be installed with a few turns of the wing nut. With the most complete line of wing unions in the world, WECO has the size, type and pressure rated unions you need for every service on the drilling rig.

Standardizing with WECO Unions means you can transport equipment, such as standard pipes, pumps, mud tanks, and other piping assemblies from one rig to another. Streamline and modernize your operations by standardizing with WECO Unions on all your rigs. Ask your WECO representative about the benefits and advantages of the WECO Union standardization program.

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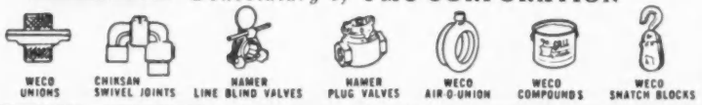

WECO UNIONS · CHIKSAN SWIVEL JOINTS · HAMER LINE BLIND VALVES · HAMER PLUG VALVES · WECO AIR-O-UNION · WECO COMPOUNDS · WECO SNATCH BLOCKS

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CHART YOUR WAY TO INCREASED PROFITS

For both contractor and company, the blue ink on a *complete* Drilling Recorder chart helps put more "black" ink on the books. Today's competitive conditions demand maximum efficiency, in drilling, in supervision, in analyzing structures drilled.

On a single chart, Totco's 3-pen Drilling Recorder gives accurate, directly comparable data for penetration, weight in suspension, and torque or pump pressure. *Only Totco* "tells the hole story" so clearly, accurately and completely . . . minute by minute . . . foot by foot.

IN USE ON OVER 300 DRILLING RIGS

In over two years of field service, the Totco Drilling Recorder has been thoroughly proved. On the Totco chart *every movement of the brake* . . . every change in weight is recorded permitting a detailed analysis of the time required for *every* operation. You can see weight on bottom at a glance. A torque record pinpoints tight spots or locked cones giving you a warning of possible trouble. Or, in lieu of torque, pump pressure may be recorded.

One driller, for example, noted on his chart that pump pressure gradually was dropping though pump operation had not changed. He pulled the string, found a hole in the pipe that soon would have caused a twist-off, saved anywhere from one to fifty thousand dollars in fishing costs.*

Totco Drilling Recorders are available throughout most of the United States and Canada on daily rental or term lease. Sold outright for export. Get complete data; write for Technical Bulletin.

*An actual case. Details on request.

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If it's a pressure gauge, dial thermometer, or needle valve, Marsh makes it...makes it in every form to suit every need...makes it better in the opinion of thousands of discriminating users. Only a few key products are illustrated here, but hundreds are described in Marsh Catalogs. Ask for information covering the product or products in which you are interested.

PRESSURE GAUGES

"Mastergauge"—the world's most effective pressure gauge for extreme service.

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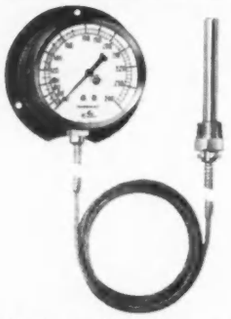
Quality series—second only to "Mastergauge" and "Master-test" for tough conditions.

Standard series—best moderate-priced gauge for run-of-plant conditions.

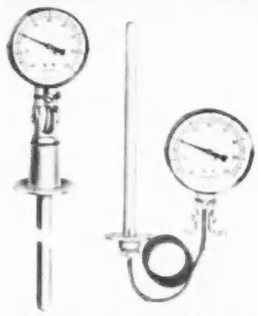
DIAL THERMOMETERS

Vapor tension thermometers—direct mounted type. Many sizes; ranges.



Distant reading thermometers—vapor-tension and gas filled types in many sizes; ranges.

Piping thermometers—specially designed for piping. Types for all purposes, including distant reading.



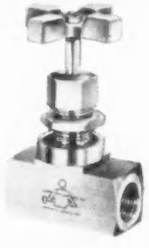
Duct thermometers—specially designed for all conditions including distant reading.

NEEDLE THROTTLING VALVES

Alloy steel—complete series of sizes and patterns. Pressures up to 10,000 psi.

416 Stainless steel—complete series of sizes and patterns in 416 stainless. Pressures up to 10,000 psi.

316 Stainless steel—complete series of sizes and patterns in 316 stainless. Pressures up to 6,000 psi.



Panel mounted—all valves—alloy steel, 416 stainless, and 316 stainless—available in panel mounted types.

MARSH

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Use **Q-BROXIN** for controlling viscosity, gels and filtration—

- in fresh water mud
- in salty mud
- in gypsum mud
- in hot muds
- in high pH muds
- in low pH muds
- in any weight mud

also—

- for emulsifying
- to breakover and maintain lime mud
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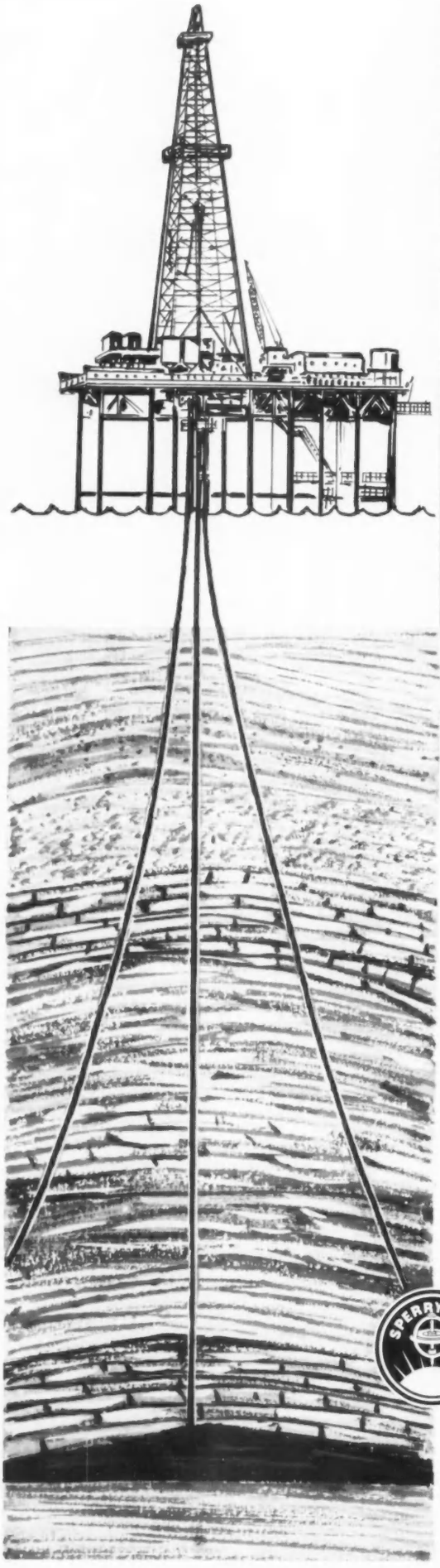

better instruments give better facts for better control...

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ORIGINATED first straight hole instrument (the Syfo Clinograph) generally accepted by the industry.

ORIGINATED only gyroscopic bore hole directional instrument in use in the United States.

ORIGINATED use of non-magnetic drill collars — an outstanding contribution to directional drilling.

ORIGINATED orientation of directional drilling tools in the bottom of hole. (Directional drilling could not be economically done without this Sperry-Sun method and the use of non-magnetic drill collars.)

ORIGINATED the taking of side wall cores.

And today Sperry-Sun leads with these better instruments and methods for better facts to give you better control on land or offshore:

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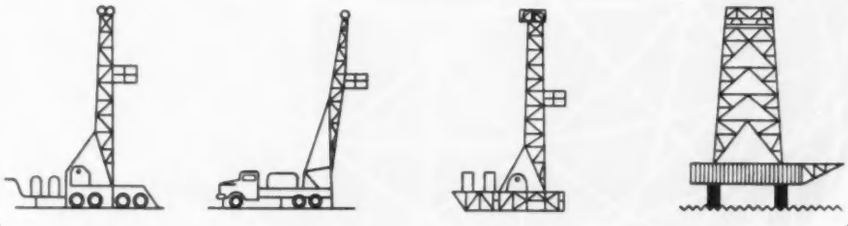

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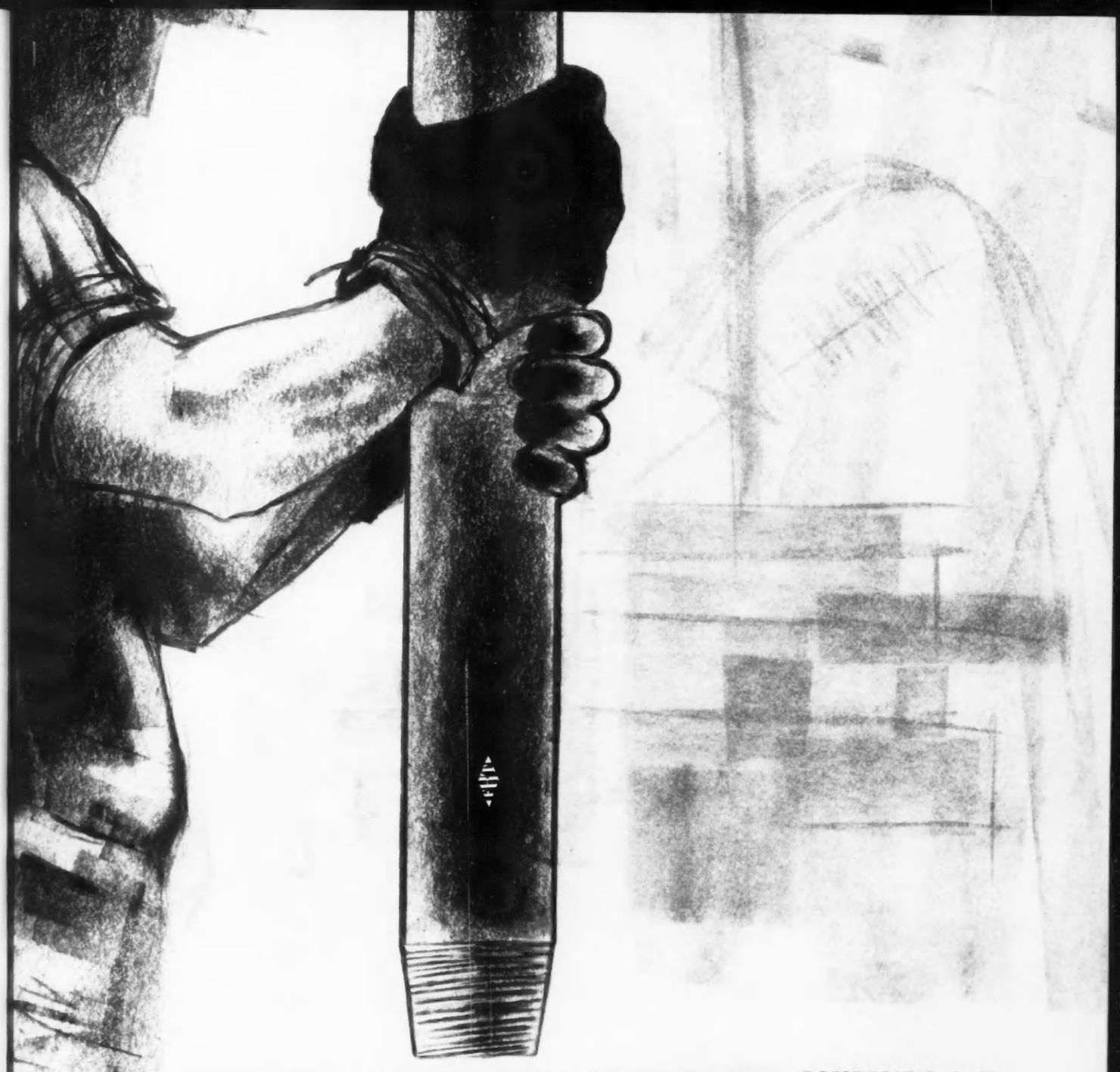

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COMPTOIR F. B. T.

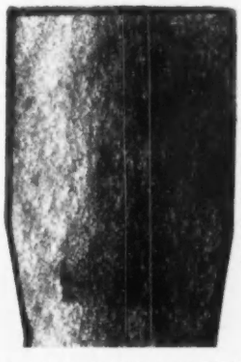
SOLE EXPORT

ORGANIZATION

FOR 5 API LICENSED

PIPE MANUFACTURERS...

PI SEAMLESS CASING, TUBING, DRILL PIPE.
NTEGRAL JOINT CASING AND TUBING.
PI SEAMLESS OR WELDED LINE PIPE.
R DETAILS, KINDLY REFER TO THE COMPOSITE CATALOG.



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FOR FASTER LIGHTWEIGHT
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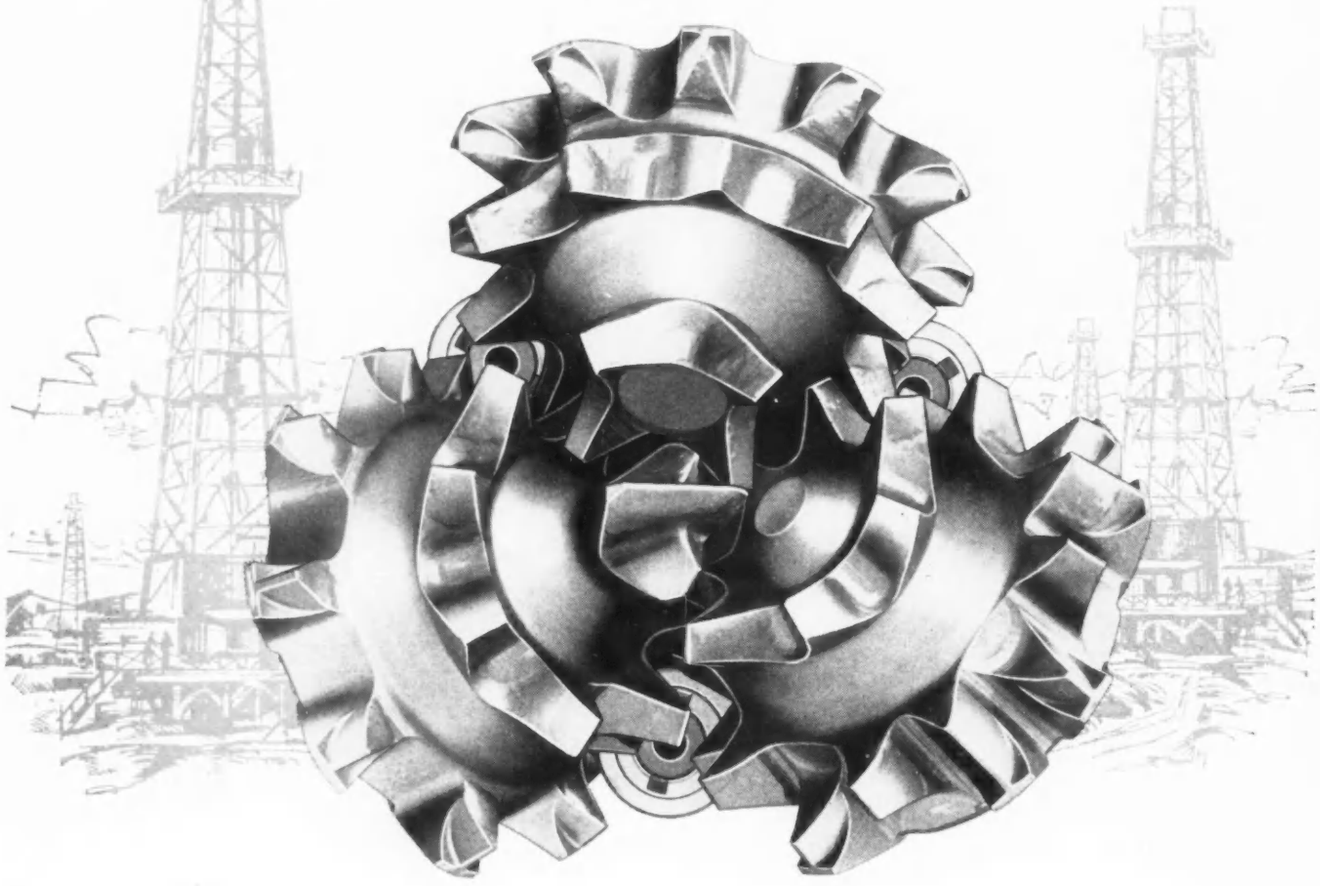
GLOBE ST3 "TASK-TYPE" JET ROCK BIT



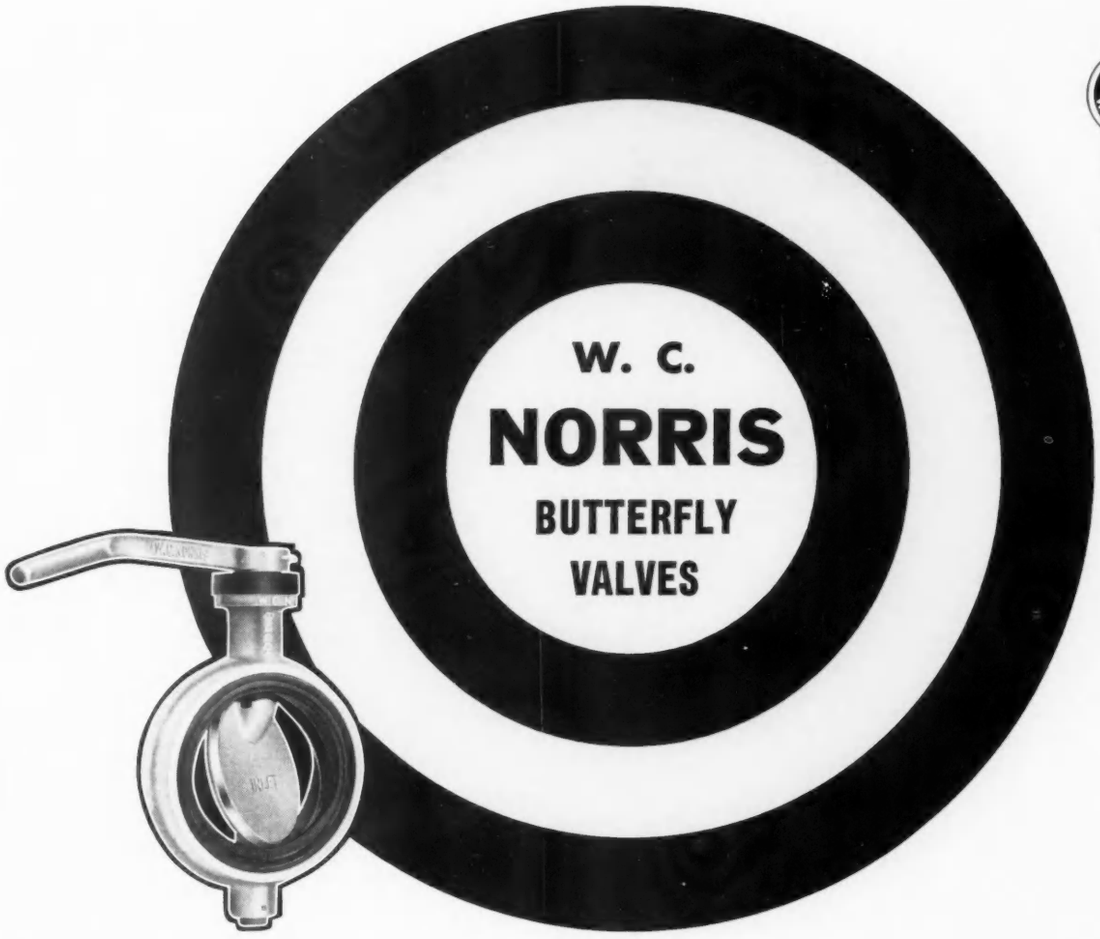
Speeds penetration rate by drilling harder formations with a coarser tooth than normally used.

Maintains a straight hole when going through hard streaks interspersed with soft formation.

All Globe 3-Cutter "Task-Type" Rock Bits are available in both regular and jet types.

GLOBE OIL TOOLS

GLOBE OIL TOOLS CO.
Main Office and Plant: LOS NIETOS, CALIFORNIA
Branches maintained in all principal drilling areas



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Now you can reduce costs and simplify valve specifying by using the highly versatile and economical Norriseal Wafer Type Butterfly Valve. Designed for working pressures to 150 psi, the Norriseal Valve features removable and interchangeable rubber and metal seats . . . takes up less line space . . . can be easily and quickly removed for "on-the-spot" maintenance . . . is field repairable. The wide selection of trim available qualifies the Norriseal Valve for use in many oil field and industrial applications.

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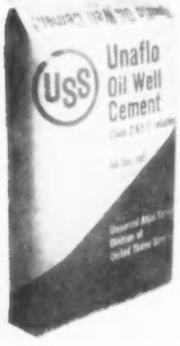
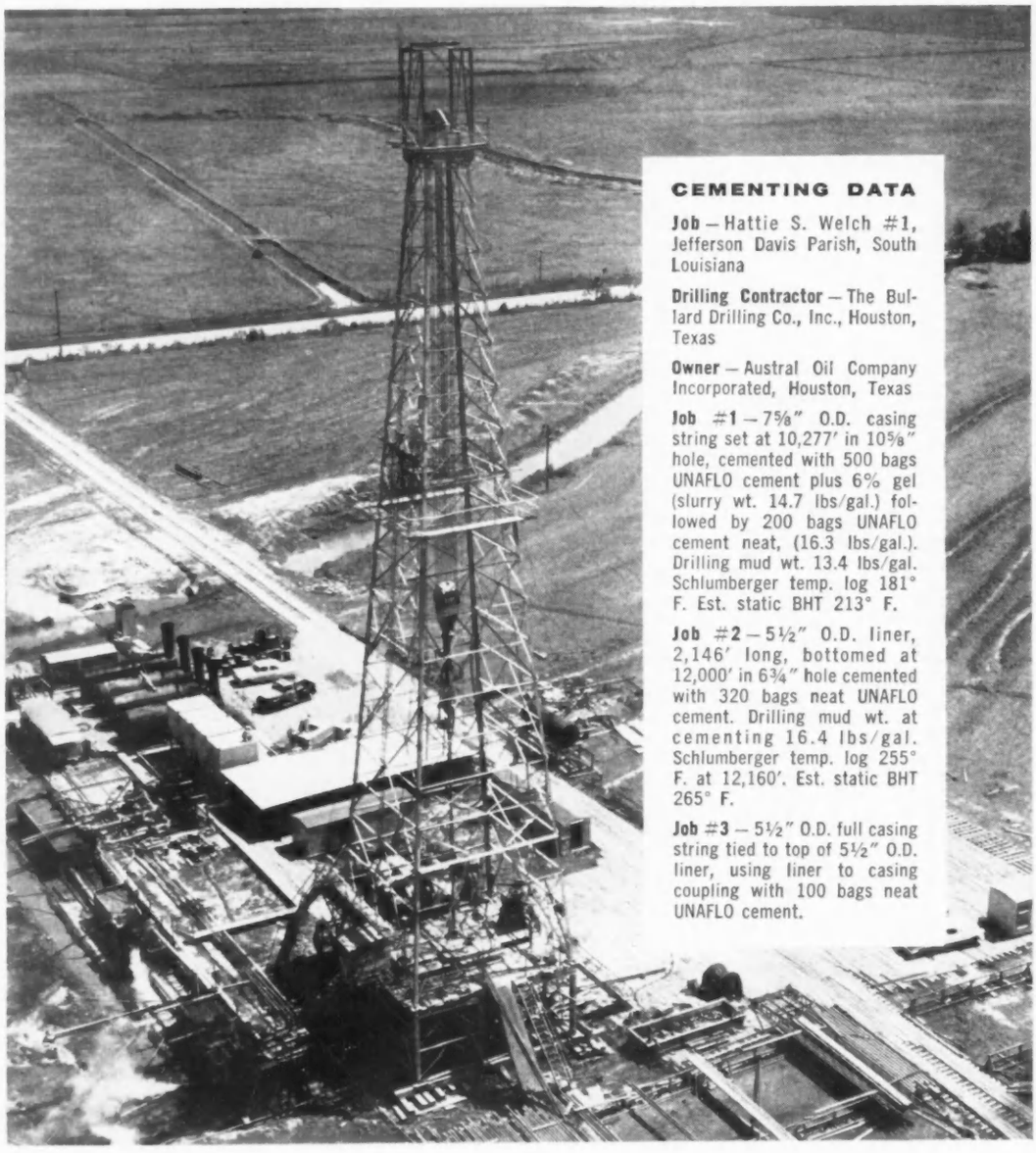
Unaflo oil-well cement,





CEMENTING DATA

Job – Hattie S. Welch #1, Jefferson Davis Parish, South Louisiana

Drilling Contractor – The Bullard Drilling Co., Inc., Houston, Texas

Owner – Austral Oil Company Incorporated, Houston, Texas

Job #1 – 7⅝" O.D. casing string set at 10,277' in 10⅝" hole, cemented with 500 bags UNAFLO cement plus 6% gel (slurry wt. 14.7 lbs/gal.) followed by 200 bags UNAFLO cement neat, (16.3 lbs/gal.). Drilling mud wt. 13.4 lbs/gal. Schlumberger temp. log 181° F. Est. static BHT 213° F.

Job #2 – 5½" O.D. liner, 2,146' long, bottomed at 12,000' in 6¾" hole cemented with 320 bags neat UNAFLO cement. Drilling mud wt. at cementing 16.4 lbs/gal. Schlumberger temp. log 255° F. at 12,160'. Est. static BHT 265° F.

Job #3 – 5½" O.D. full casing string tied to top of 5½" O.D. liner, using liner to casing coupling with 100 bags neat UNAFLO cement.

compatible with various additives...

UNAFLO oil-well cement is successfully used neat or with various types of additives in more and more cementing operations. For cementing casing or liner, squeeze cementing, plug-backs or recementing, UNAFLO cement slurries pump easily and set hard to provide an adequate seal. Its retarded set sustains high initial fluidity despite high temperatures and pressures. This allows time for proper placement plus a margin of safety for delays or emergencies.

For more information, write Universal Atlas Cement, 100 Park Avenue, New York 17, N. Y.

Universal Atlas Cement
Division of
United States Steel

U-163

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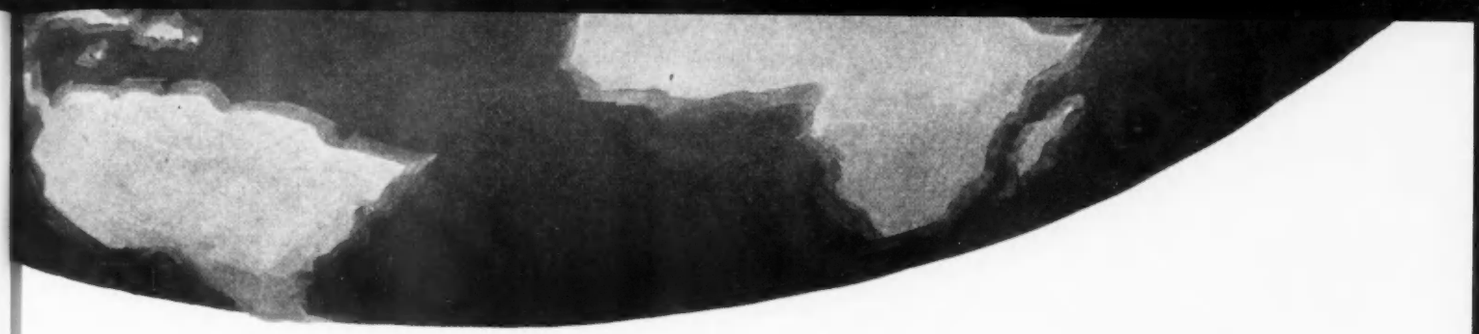

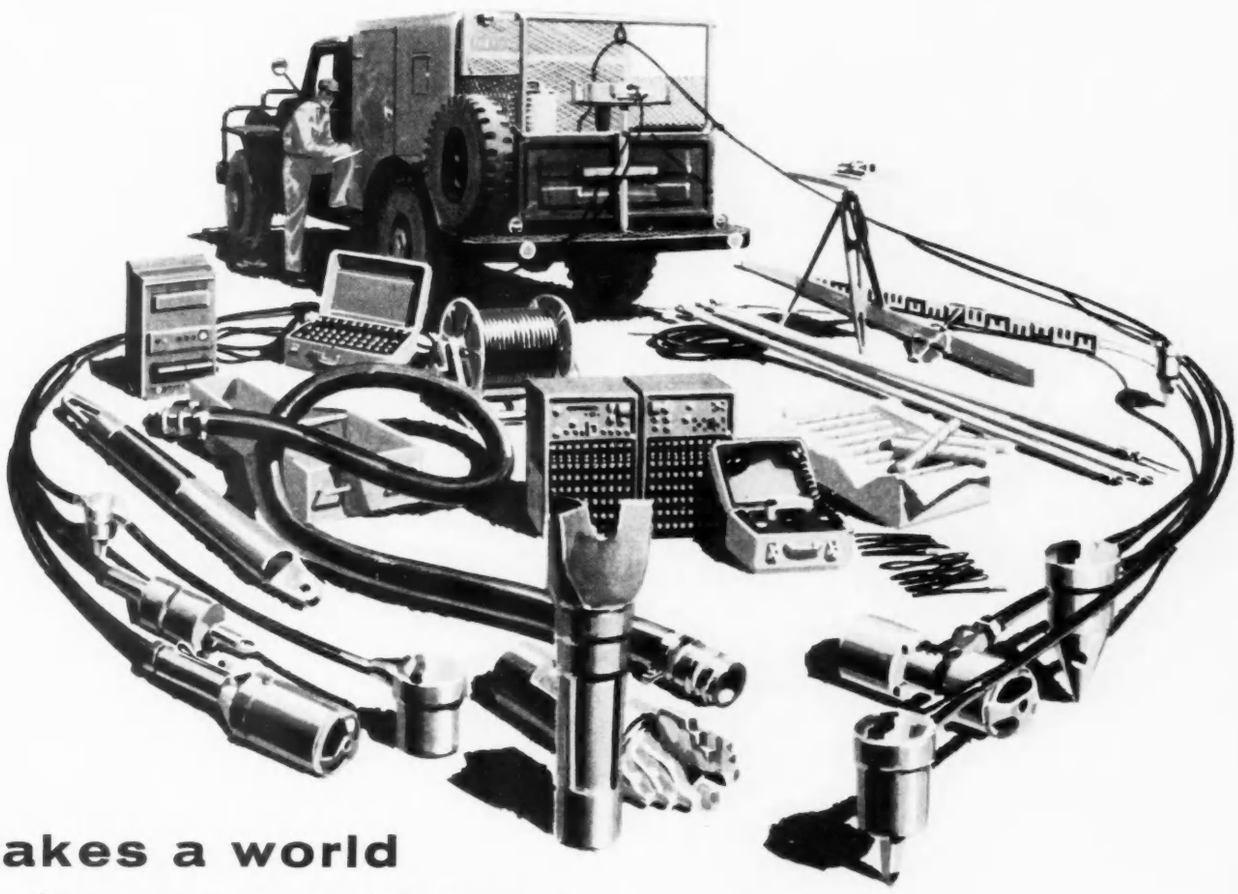

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Skilled Tube-Kote inspectors approve coating quality for each length of pipe prior to shipment.

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You can specify Tube-Kote coatings with the assurance that every length of tubing or drill pipe will be full length inspected for coating holidays or defects. Tube-Kote's exclusive automatic inspection unit is far more accurate than previous methods. First, power supply is constant. Second, movement of the detector lance is uniform, and third, the probe sponge maintains uniform wetness by a constant feed of the electrolyte. That's why Tube-Kote can inspect the coating on each length faster and more accurately. It's another reason Tube-Kote continues to be the industry's leader. Next time specify Tube-Kote!

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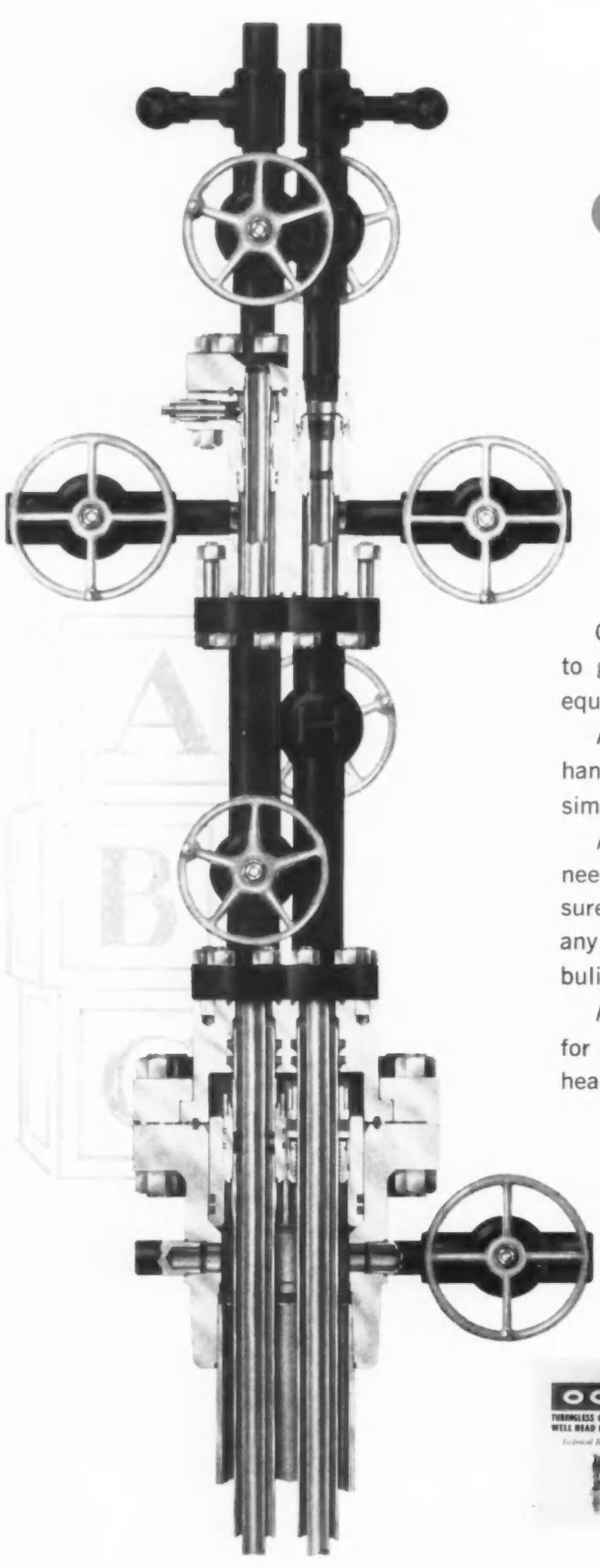


Tubingless Completions are simpler with O·C·T equipment

O·C·T tubingless completion equipment is designed to give you simplicity and flexibility that simplify your equipment problems.

A complete line of interchangeable slip and threaded hangers lets you suspend from one to eight tubing strings, simply by changing hangers.

A variety of casing heads for these hangers meets your needs for single or multiple completions, at working pressures up to 10,000 psi. Master Bushings allow assembling any desired multiple completion and permit running turbulizers, centralizers or other related downhole equipment.

A new type M (for macaroni) tubing head is supplied for hanging 1½-inch and smaller tubing strings. These heads can be furnished with either flanged or threaded connections on top and bottom. Crescent flanges, tri-flanges, and quadri-flanges are available.

If you want to use an economical tubingless completion on your next well, talk with your nearby O·C·T representative. He can show you the latest in tubingless completion equipment.

Write for the helpful free booklet, "O·C·T Tubingless Completion Well Head Equipment," which discusses requirements for tubingless completion equipment.

where progress is a daily practice

O·C·T

OIL CENTER TOOL CO.

SUBSIDIARY OF FMC CORPORATION

Address Export Inquiries for All Countries to
P. O. Box 3091, Houston, Texas

We stored a bag of Diamond Flake Caustic Soda under water for 3 weeks

June 27. A bag of Diamond Caustic Soda was placed at the bottom of the pool facing the entrance of Diamond Research Laboratories at Painesville, Ohio. "Just to see what would happen."

July 17. This bag was recovered from the pool. Not broken. No caustic leaking. The *printing* on the bag was blurred a little, but the bag was perfect. "Drums would have leaked and corroded."

July 17. Caustic was poured from the bag—just as flaky, free-flowing and dry as the day it was put in the pool. Caustic in drums would have been completely unusable.

Any day. Bags beat drums as a way of handling and storing flake caustic soda. Diamond bags have three plies—kraft for appearance and handling, burlap for strength and puncture resistance, polyethylene to seal out moisture.

IT'S IN THE BAGS

Diamond Caustic Soda in bags can be where you are. Once you've handled it that way, you'll never go back to clumsy, expensive drums you can't even burn when you want to get rid of them. For information, write Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals

W-K-M
DIVISION

ACF INDUSTRIES

Houston, Texas

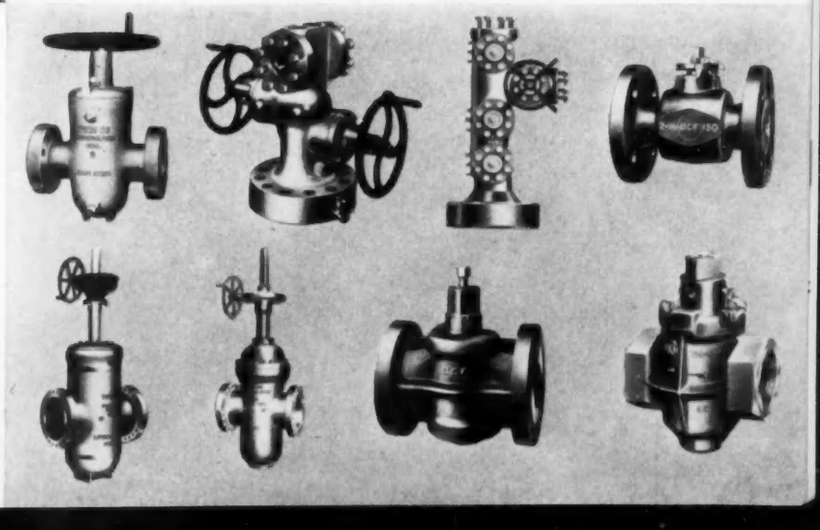
A CREATIVE TOUCH BEYOND "JUST THE NECESSARY" GOES INTO EVERY W-K-M VALVE

Take the way that W-K-M tool engineers found to gain uniformly higher accuracies in valve manufacturing. They designed and built a complex, new transfer machine that could do the job. An electronic brain guides it in precision machining eight gate-valve bodies simultaneously . . . milling, turning, boring, drilling and threading, self-gauging each operation to insure an unparalleled degree of uniformity.

This is just one example of the many continuing efforts by W-K-M engineers to go beyond "just the necessary" to bring you the best possible valves through highly creative approaches to difficult engineering and manufacturing problems. And who benefits from W-K-M's creativity in action? You do . . . of course.

When So Much Depends On a Valve

. . . *Specify* W-K-M

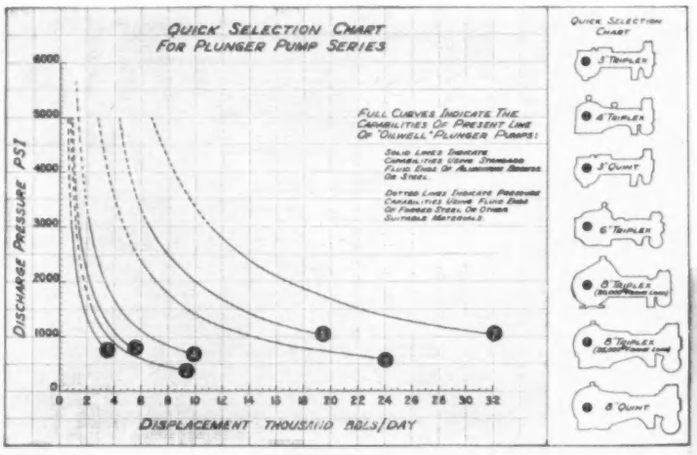


The "OILWELL" string...

PRODUCTS
SERVICES
STORES

How to take the guesswork out of plunger pump selection

A mistake in horsepower, capacity, pressure requirements or suction and discharge piping arrangements can be costly. Here's a simple, nearly error-proof way of sizing the best plunger pump for your fluid-injection use—get your copy of "Oilwell's" new "Plunger Pump Selection Manual" without delay.


QUICK SELECTION CHART FOR PLUNGER PUMP SERIES
FULL CURVES INDICATE THE CAPABILITIES OF PRESENT LINE OF "OILWELL" PLUNGER PUMPS:
SOLID LINES INDICATE CAPABILITIES USING STANDARD FLUID ENDS OF ALUMINUM BRONZE OR STEEL
DOTTED LINES INDICATE PRESSURE CAPABILITIES USING FLUID ENDS OF HARDED STEEL OR OTHER SUITABLE MATERIALS
DISCHARGE PRESSURE PSI
6000
5000
4000
3000
2000
1000
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
DISPLACEMENT THOUSAND BBLS/DAY
QUICK SELECTION CHART
3" TRIPLEX
4" TRIPLEX
3" QUINT
6" TRIPLEX
8" TRIPLEX
8" TRIPLEX
8" QUINT

The manual describes in detail "Oilwell's" complete line of seven primary pumps. Volume-pressure range curves make it a simple matter to pick the pump that's right for the job. Picking plunger sizes is simple, too, because you'll find complete performance data for all plunger sizes available with each size pump. The selection manual also contains a wealth of other information including how to apply the pumps and how to size and arrange suction and discharge piping.

Write on your company letterhead for a free copy of "Oilwell's" Manual M29-1060. It's one of our ways of making sure that when you buy "Oilwell" equipment, you get a lot more than our product.

Why "Oilwell" waterflood pumps take it lying down

The pumps in the picture are operating in the New Odom field, and one of them has been pumping 24 hours a day for *eight months* without stopping. Naturally, it's an "Oilwell" pump and its design has a lot to do with its performance.

Every "Oilwell" plunger pump is designed horizontally for eight good reasons: *Low suction* . . . lowness of suction and discharge lines means maximum utilization of suction head and simplifies piping layout. *Less deadweight on crankshaft* . . . eases bearing loads, minimizes vibrational stress in frame and piping. *Simpler thrust transmission* . . . eliminates overhead yoke and pull-rod assemblies. *Cleaner installations* . . . any leakage is confined to frame cradle by gravity. *Natural valve motion* . . . fewer parts needed. *Low center of gravity* . . . reduces vibration that can cause piping stress and fatigue. *Safer maintenance* . . . does away with ladders and neck-craning. *Easier maintenance* . . . greater accessibility.

There's a wide selection of top-performing "Oilwell" Triplex and Quintuplex pumps for waterflood applications, LPG Flood, Pressure Maintenance, Formation Fracturing, Acidizing and Cementing, Salt Water Disposal, or you name it. Whatever your requirements, call on your "Oilwell" representative for complete information and help in the planning stage.

USS and "Oilwell" are registered trademarks

Off the shelf

It's all on the shelves in an "Oilwell" store, everything from subsurface pumps to mud gauges. Whatever you need in the way of production or drilling equipment, and whenever you need it, your nearest "Oilwell" store can take it off the shelf, load it, and it's no more than a short trip from your lease. That's because there are "Oilwell" stores, sales offices, warehouses and conversion centers (*and* pump shops) located *throughout* the oil country. If you're near oil, you're near an "Oilwell" store.

USS Oil Well Supply Division of United States Steel

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For more data on advertised products, use cards, last page.

THE INSIDE STORY OF GROVE VALV-PAK

Compact · Versatile

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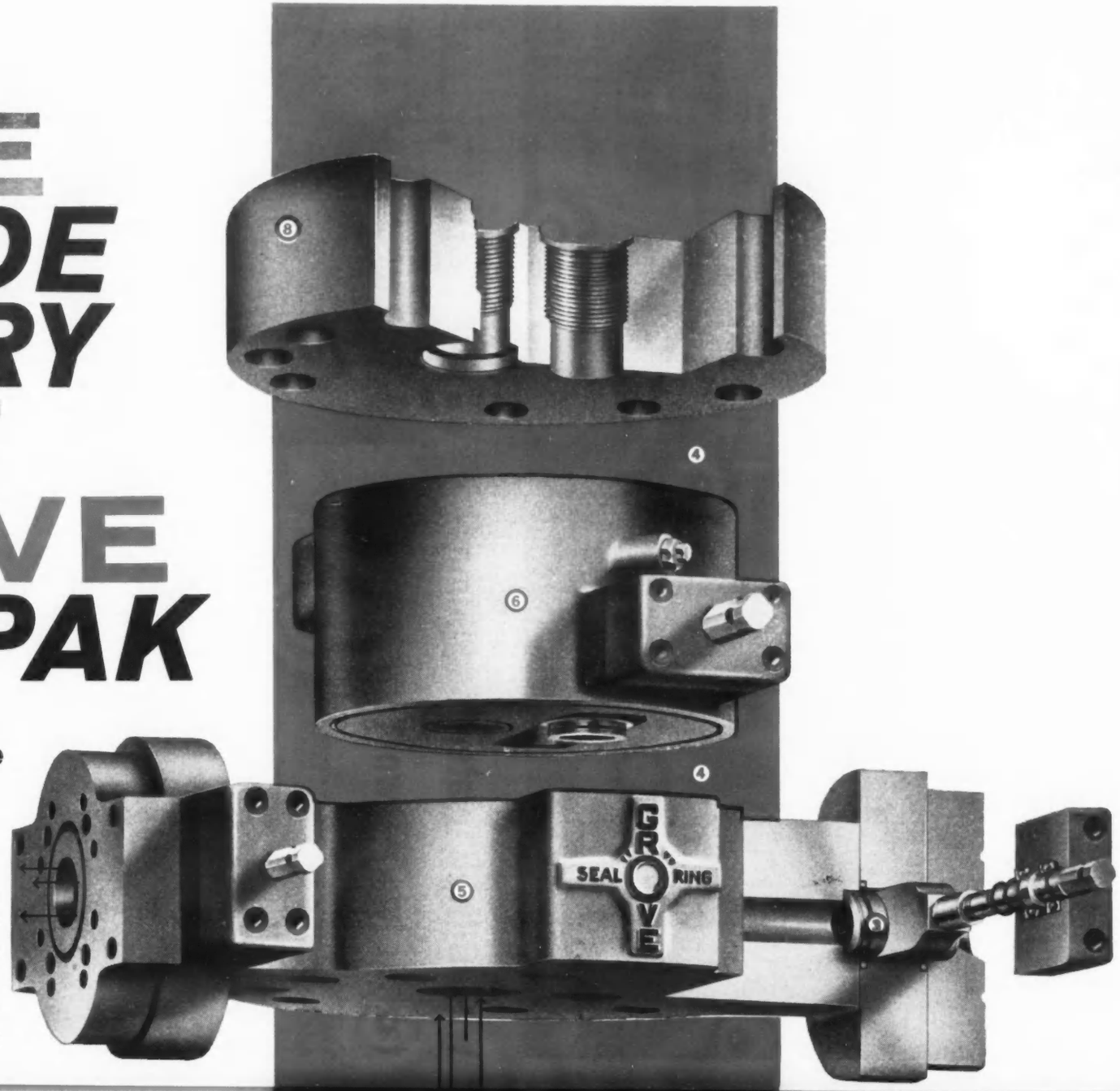
Grove Seal-"O"-Ring® Valv-Pak combines the compactness and light weight of an integral Christmas Tree valve assembly with the flexibility of a conventional wellhead manifold that permits any single component to be changed without replacing the complete unit.



complete unit.

CHECK THESE GROVE VALV-PAK FEATURES:

1. Patented Grove Seal-"O"-Ring design for double-action seal. Metal inner seat rings give primary metal-to-metal seal backed up by O-Rings.
2. Precision-finished stems with lifetime lubricated ball bearings.
3. No lubricants or sealing compounds needed. Squeegee action of O-Rings against gate assures a clean polished surface for bubble-tight metal-to-metal seal.
4. Adaptable to meet any need. Unique Grove Valv-Pak construction gives ultimate flexibility. Valv-Pak can be factory tailored to your precise needs. Parts damaged by erosion or corrosion may be replaced in the field faster and more economically than with conventional designs.
5. Wing valve cross can be furnished in full opening or reduced port design.
6. Swabbing valve (optional).
7. Through conduit, full opening design for ideal flow characteristics and for accommodating down-hole tools.
8. Top and bottom flanges may be supplied to accommodate any wellhead fabricator's specification.
9. Studs furnished for all flanged outlets.

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GROVE VALVE AND REGULATOR COMPANY
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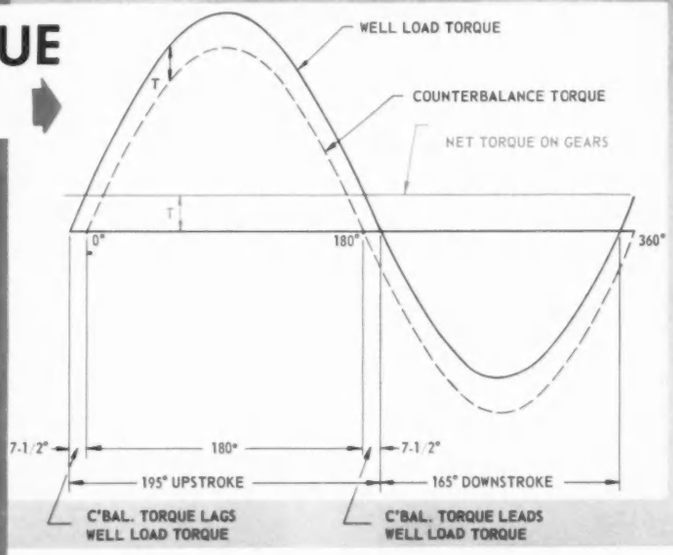
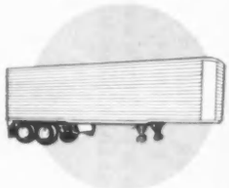
- UNIFORM TORQUE INCREASES GEAR AND BEARING LIFE.

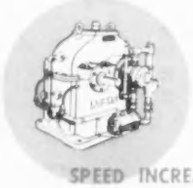


PUMPING UNITS

GAS ENGINES



TRAILERS



SPEED INCREASERS AND REDUCERS

HERE'S HOW . . .

By placing the pitman cross yoke forward of the vertical centerline of the crankshaft the upstroke occurs during 195° crank rotation and the downstroke 165°. This lowers the upstroke acceleration where the load is greatest, effecting a reduction of polished rod load.

The forward position of the cross yoke substantially increases the mechanical advantage for lifting the load and reduces the advantage on the downstroke where the load is less.

The counterbalance weights, being offset approximately 24° on the crank, produce a counterbalance torque which "lags" the well torque at the beginning of the upstroke by 7½° and leads the well torque by 7½° at the beginning of the downstroke. (See illustration above)

Independently, these features would not produce a uniform torque, but working together a "unitorque" system is obtained which in turn can effect a torque reduction on the gear reducer up to 35%.

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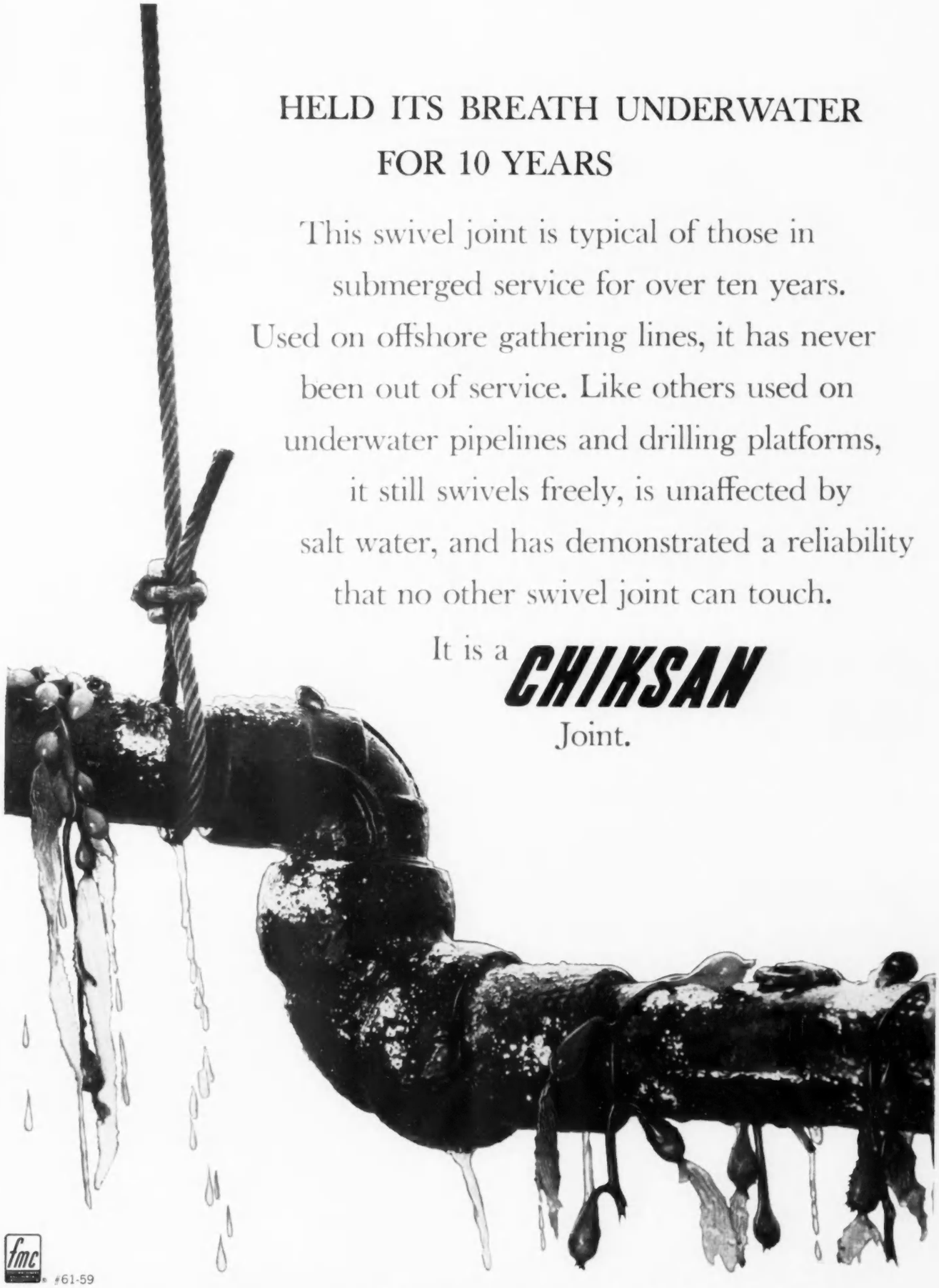
This swivel joint is typical of those in submerged service for over ten years. Used on offshore gathering lines, it has never been out of service. Like others used on underwater pipelines and drilling platforms, it still swivels freely, is unaffected by salt water, and has demonstrated a reliability that no other swivel joint can touch.

It is a **CHIKSAN** Joint.



fmc #61-59

CHIKSAN COMPANY—General Offices: Brea, California • Well Equipment Mfg. Corp. Division (Weco Unions, Hamer Valves) • Chiksan International • Chiksan of Canada Ltd.

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3 CLEAN/OVER-ALL PROTECTION

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4-WAY JOB INSURANCE

Capitol forged steel unions have built-in insurance to give 4-way trouble-free service!

(1) *Leak-proof connections* assured because Capitol unions have *more* threads, accurately cut and double-checked according to Army-Navy gauging practice. Both hand-tight and pressure-tight threads are checked, two operations instead of the one required for American Standard gauging. The extra threads mean on-the-job assurance of tight installations. (2) *Positive seating* because each union is individually pressure-tested. (3) *Clean/over-all protection*, each male and female part completely phosphate coated; each nut electro-zinc plated. (4) *Easy wrenching/faster make-up* because all three parts have a definite octagon shape.

You get all 4 important advantages at no extra cost when you specify CAPITOL forged steel unions . . . one of the full-line of Army-Navy gauged forged steel fittings.

Now more than one million in service and not a single failure.

CAPITOL MANUFACTURING CO.,
Division of Harsco Corporation, Columbus, Ohio.

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Drawworks with Guts to Go ...for Years

No lightweights, those Brewster drawworks. There's a legion of men in the oil world who will testify to that.

TAKE BREWSTER'S N-55 ROTARY RIG DRAWWORKS

This medium depth drawworks has the ruggedness and brawn typical of all Brewster drawworks. Depth rated to 8,000 feet with 4½" drill pipe, it uses a maximum of 600 horsepower. Clutches are mounted outboard on the main drum shaft for ease of servicing. The entire drum shaft assembly is a complete unit and may be removed in the field for maintenance or service. The drum core is formed from thick walled steel, heavily ribbed to prevent crushing.

TRANSMISSION

The compact chain transmission features Brewster's field proved graduated speed design with four forward speeds, each a 38% increase. When combined with the high and low drum drives, eight forward and two reverse speeds are available for hoisting. Four forward and two reverse speeds are available to the rotary.

COMPOUND

Box type oil bath roller chain compounds are provided for either two or three engine hook-up. By means of individual clutches, motors may be used singly or in combination for individual operation of the pump and drawworks. Fawick air clutches connect each engine to compound shafts, thus providing air-cushioned power, and eliminating many parts.

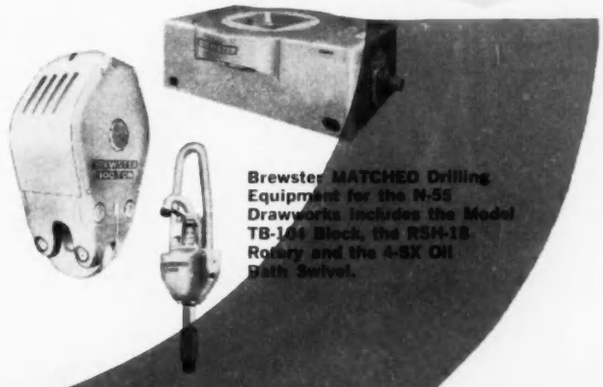
BRAKES

Brakes are full 325° wrap, having 1" x 8" linings on 40" diameter drums, with a total braking surface of 1,728 square inches. They are of the compound equalizing type and are self-energizing to provide holding power with minimum manual effort.

Get complete information on Brewster equipment now. See your Brewster dealer or write or call Brewster.

SPECIFICATIONS BREWSTER N-55

Recommended Horsepower	600
Drum Brake Diameter x Width	40" x 8"
Drum Core Diameter x Length	18" x 40"
Size of Brake Lining	1" x 8"
Net Braking Surface (Lining) Square Inches	1,728
High Speed Drum Clutch	Fawick Friction
Low Speed Drum Clutch	Fawick with Positive Auxiliary
Transmission:	
Forward Speeds	4
Reverse Speeds	1
Size Main Skid Members	12 x 12 H
Approx. Overall Height	72"
Approx. Width of Skids	7' 1"
Length	26' 8"—2 Eng.
Length	30' 10"—3 Eng.
Approx. Weight of Drawworks, less engines	36,000 lbs.

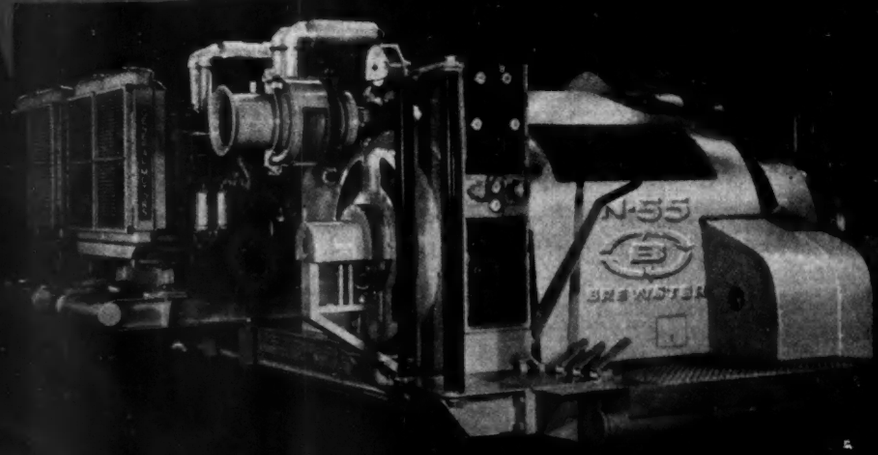


Brewster MATCHED Drilling Equipment for the N-55 Drawworks includes the Model TB-104 Block, the RSH-18 Rotary and the 4-SX Oil Bath Swivel.

BREWSTER N-55

ROTARY RIG DRAWWORKS

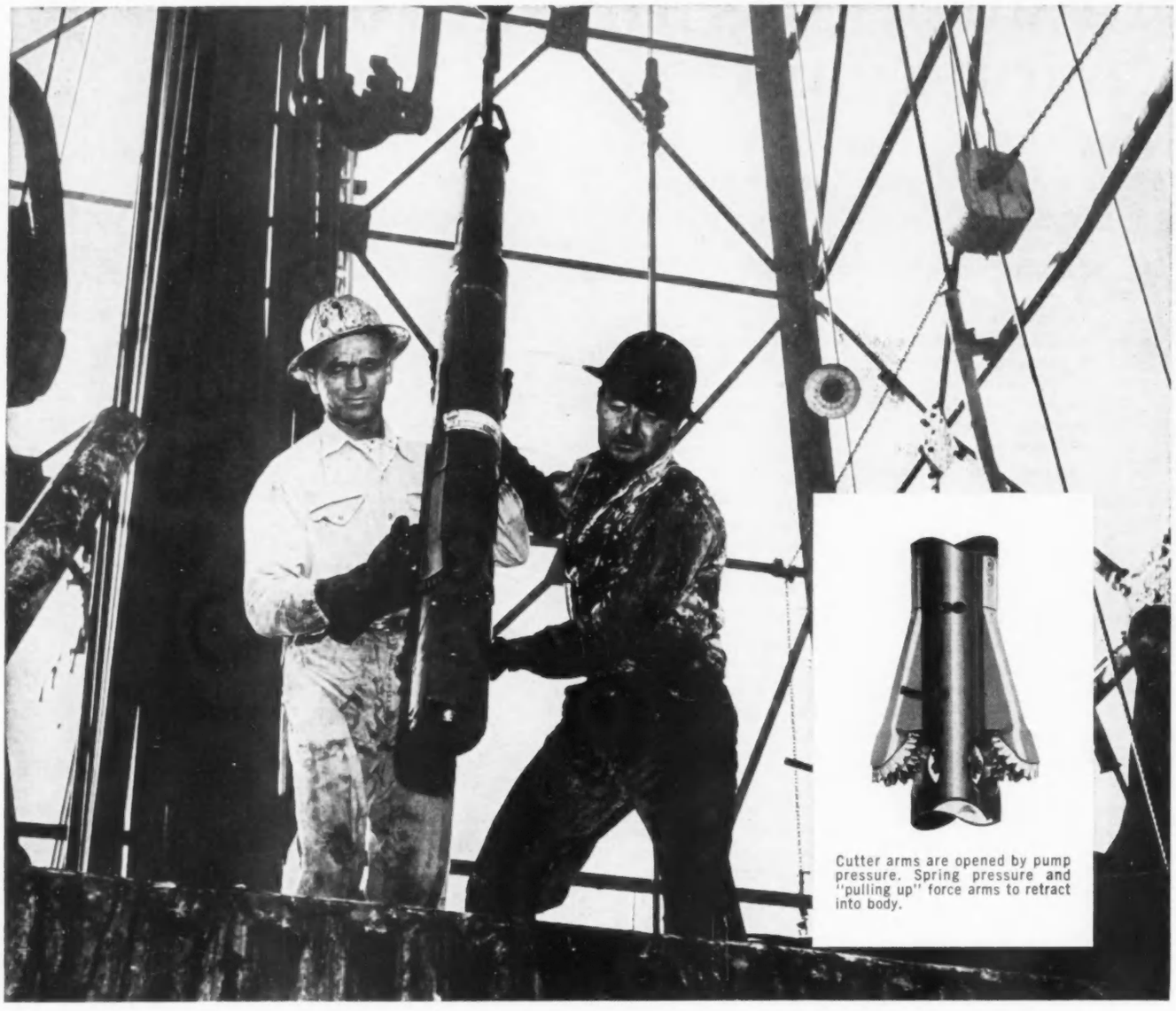
Fast drawworks for medium depth drilling available with Torque Converter, Fluid Couplings or Direct Mechanical Drive



THE BREWSTER COMPANY, INC.

P. O. BOX 1095, SHREVEPORT, LOUISIANA
TELEPHONE 424-3254

PRODUCTS OF CREATIVE ENGINEERING



Cutter arms are opened by pump pressure. Spring pressure and "pulling up" force arms to retract into body.

New Servco Hole Opener drills like a rock bit ...opens hole up to 3 times faster!

- Enlarges hole up to twice the drilled diameter in hard or soft formation.
- Positive opening by direct pump pressure.
- Full volume circulation at all times.
- Choice of fluid flow—substantially through the pilot or entirely through cone recesses.
- Choice of cones for the most efficient cutting.
- Simple, rugged construction. A minimum of parts insures trouble-free operation.

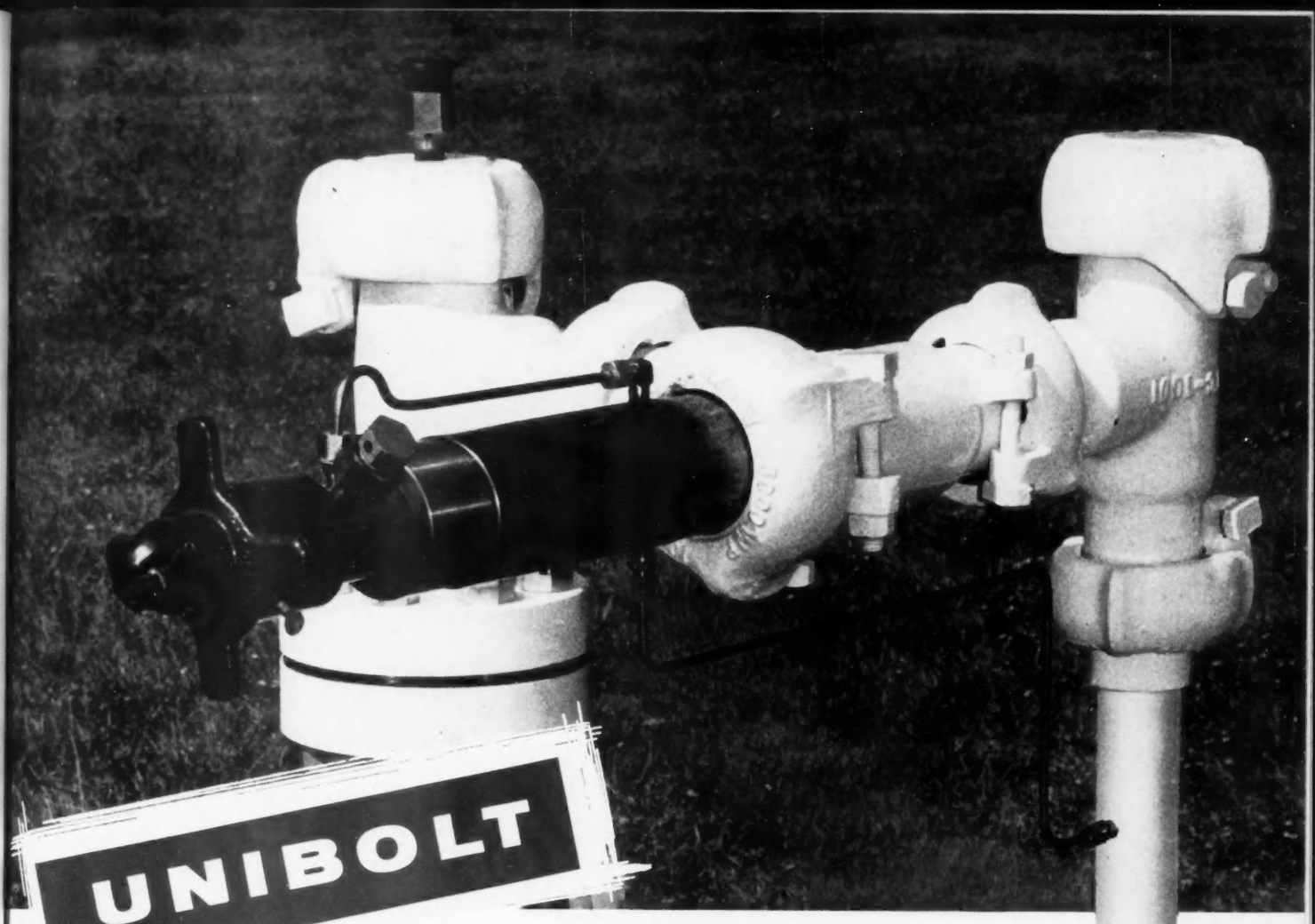
Just a casual look at the new Servco Expandable Hole Opener tells you it's a *simple*, rugged tool, built to take a lot of hard downhole use. A closer look reveals the secret of its exceptionally fast penetration—the use of *rock bit-style* cones. In operation, the Servco Hole Opener drills like a rock bit. Actual job records show holes can be opened (up to twice the drilled diameter) three times faster than with conventional hole openers. Cementing, gravel packing... any casing clearance operation... can be completed faster and more effectively, resulting in important rig-time savings.

Call your Servco field man on your next hole opening job. He'll be glad to work with you to get the maximum results.

SERVCO
...the modern drilling tools

General Offices: 2440 Cerritos Ave., Long Beach 6, California
Canada: 6909 104th St., Edmonton, Alberta • **Venezuela:** Apartado 198, Maracaibo
France: 106 rue Lauriston, Paris 16 • **Trinidad:** P.O. Box 104, San Fernando
Mid-East: Macridge Petroleum Equipment-Supply Co., S.A.L. Beirut, Lebanon

Field Offices: Ventura, Bakersfield, Lafayette, Harvey, Casper, Oklahoma City, Houston, Odessa, Denver, Farmington, Williston, Carmi



UNIBOLT

Pressurematic Valves

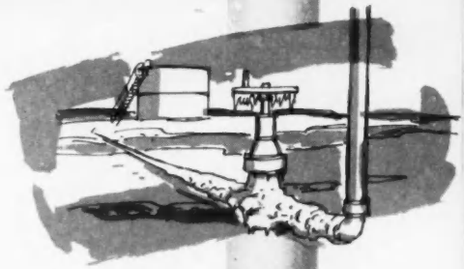
Provide dependable, low-cost insurance against all flow-line hazards

Here is a valve that does the work of two valves yet costs little, if any, more than a good high pressure valve. It is both a high-low safety and a Christmas tree wing valve.

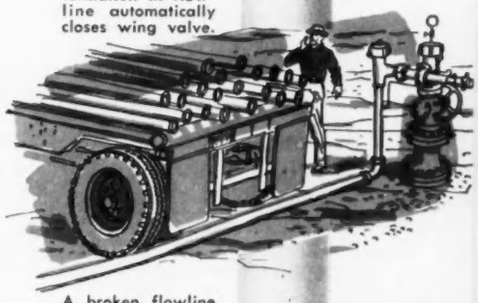
The UNIBOLT PRESSUREMATIC VALVE combines all of the time-tested and proven features of the Unibolt Adjustable Wing Valve with a novel automatic actuating accessory. The valve closes instantly when a predetermined pressure balance across the seat is disturbed. The actuating mechanism consists of a small piston which is exposed to well pressure and a larger piston which is exposed to flowline pressure. A broken flowline or open valve, for example, in the production system, would lower the flowline pressure and thus instantly close the valve. Once closed, the valve may be easily opened and set manually for automatic operation. The downstream or low pressure line may be tapped at any remote point and thus embrace any desired portion of a gathering and treating system. Offshore and other remotely controlled wells could be shut in automatically in case of fire, ship collision, etc. The unique design lends itself to many such applications.

Send for literature or contact your nearest Unibolt sales representative.

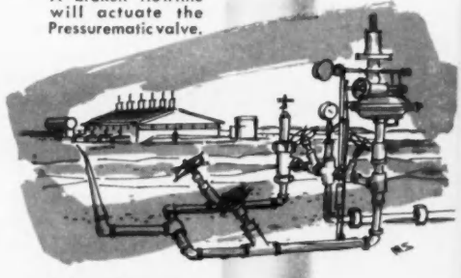
YOU CAN CONVERT YOUR UNIBOLT ADJUSTABLE WING VALVE TO "PRESSUREMATIC."
The regular UNIBOLT Adjustable Wing Valve can be readily converted to "Pressurematic" by replacing the stem/bonnet assembly with the Pressurematic unit.



Freezing or hydrate formation in flowline automatically closes wing valve.



A broken flowline will actuate the Pressurematic valve.



Failure of a pressure regulator on pipe line gathering manifold would shut in the well.

UNIBOLT

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

FIRST CHOICE
of Oil Field equipment builders

NOW AVAILABLE FOR REPLACEMENT *at no extra cost!*

DIAMOND PRESS-FIT CENTERPLATE ROLLER CHAIN

. . . supplied in custom lengths with **B**ushed **C**enterplate Connecting **L**inks

(Diamond Patent No. 2,466,639)

For many years DIAMOND *Multiple Strand* Roller Chain having centerplates Press-Fit on the pins has been *first choice* with builders of heavy-duty oilfield equipment . . . for these very good reasons:

1. DIAMOND *Press-Fit Centerplate* construction eliminates wear at centerplate holes. It distributes the load uniformly over *all* linkplates, giving the chain higher fatigue strength and greater capacity for shock or continuous loads, than has been experienced with any other chain.
2. Continued uniform distribution of load, even under severe operating conditions, adds substantially to the life of the chain, reducing replacement costs and equipment downtime.

DIAMOND *Press-Fit* roller chain is now available for installation or replacement in the field. Connecting links with precision-ground center-plate bushings (BCL Links) may be fitted with *hand pressure* and have virtually 95% of the shock load capacity of press-fit links.

DIAMOND *Press-Fit* Centerplate Roller Chain, for all its proven advantages, *costs no more* than slip-fit chain. It is available in multiple-strand, custom lengths from ¼″ to 2½″ pitch, for a complete range of oilfield applications.

Order DIAMOND *Press-Fit* Centerplate Roller Chain for all replacement needs. Available from Indianapolis factory or from Dallas Factory Warehouse.

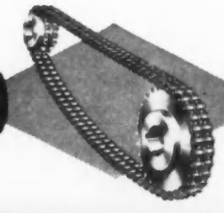
DIAMOND CHAIN COMPANY, INC. · DEPT. 485 · A SUBSIDIARY OF AMERICAN STEEL FOUNDRIES · 402 KENTUCKY AVE., INDIANAPOLIS 7, INDIANA

NEW DALLAS FACTORY WAREHOUSE AND SALES OFFICE ***carries full stocks of DIAMOND Roller Chains***

South and Southwest oilfield operators may now obtain overnight service on orders for DIAMOND Press-Fit Centerplate Roller Chain in *custom lengths* with Bushed Centerplate Connecting Links. Address your orders to: DIAMOND CHAIN COMPANY, INC. • 9119 Diplomacy Row, Brook Hollow • Dallas 7, Texas

Phone FL 7-6669

TULSA OFFICE: 2238 Terwilleger Blvd., Telephone RI 2-1960



DIAMOND ROLLER CHAINS ®

the thick and thin of drilling muds

(Why one CMC gives you better viscosity control than any other)

When you want to BUILD viscosity and still maintain excellent fluid loss control—for example, in low-solids mud areas like West Texas or the Rockies—you can save money by using Du Pont High Viscosity Qualex®, the one refined CMC that builds viscosity better than any other on the market. *Proof:* In comparison tests, "Qualex" produced the desired viscosity and fluid loss control at 25¢ lower cost per barrel of mud than the next-best brand.

When you want to HOLD DOWN viscosity and still maintain excellent fluid loss control—as in the high-solids muds of the Gulf Coast—use the only refined CMC that does *not* add to mud viscosity. It's Du Pont Low Viscosity "Qualex"—in the blue bag that promises the most economical fluid loss control *and* saves you the cost of extra thinners.

You may be among the many operators already saving mud-viscosity dollars with "Qualex". If not, it can pay you to call your mud supplier today and ask him to send some out for a trial run. (He also carries Du Pont "DM" grade CMC in both high and low viscosities; lower purity, but good economy.)

Chemical Products Sales Division, Explosives Department, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

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Phone: MOhawk 7-9197

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Los Angeles 58, Calif.
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DU PONT "QUALEX" CMC

Better Things for Better Living . . . *through Chemistry*

40,000 lbs. of mud pump being loaded on a Mack B61S belonging to B. M. Keller & Co., Inc., trucking contractors of Pampa, Texas. Driver W. W. Mays says "These Macks always get us where we're going and handle like a dream no matter where we take them."

Where more is demanded of a truck

You get more out of a Mack!

Draw works, mud pumps, drill rigs . . . the massive equipment used in oil field work is strictly in the heavyweight class. And when it comes to muscling around this kind of equipment, experienced oil field men know they can do it better with the strength and stamina that Mack trucks bring to the job. No ordinary trucks stand up to the wracking cross country hauls, the tortuous trips to off-highway drill sites, the way a Mack does.

The ability to get through—no matter what the weather or terrain—has made Mack the outstanding choice for tough oil field service. Extra strong frames and chassis take jolt and shock in stride, and the Mack exclusive Balanced Bogie with Power Divider transmits a bias of torque to the wheels with the best traction—gives Mack six-wheelers the ability to tackle the worst kind of going without bogging down.

Contact your nearest Mack Branch or distributor for proof of how a combination of Mack-built components like the exclusive Balanced Bogie with Power Divider can soften up your toughest hauls . . . make bogdowns and breakdowns a thing of the past. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

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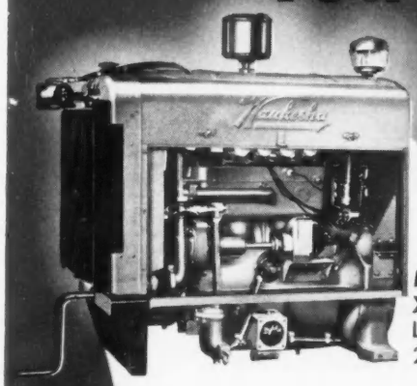
MACK
FIRST NAME FOR
TRUCKS

MACK
for over 8 straight years
NO. 1
by far in sales of diesel trucks

You can't BEAT this EXPERIENCE



Model XAHU
Long Life Unit,
21 **continuous** hp

over 30 years proven top performance by WAUKESHA GAS ENGINES in the world's oil fields

It's easy to pick a gas engine that's really "tailor made" to your needs. Get a Waukesha *designed-for-gas* engine! Then you can be sure—before you buy. The Waukesha gas engine line is *complete*. You can get exactly the right engine. The Waukesha combination of *designed-for-gas*—and built-for-gas construction features, and first quality materials—that means low fuel and lubrication costs—is the result of Waukesha's over fifty years' experience in building fine engines. Reliability is *built-in*. Most important of all—Waukesha Gas Engines have *proved* their reliability, economy and long life in all the oil fields of the world. In thousands of varied applications . . . for more than thirty years. That's why *Waukesha* is the word for *dependable* full rated horsepower on gas fuel.

Send for descriptive literature.

10 to 1027 hp

61 to 5788 cu. in. displacement

WAUKESHA MOTOR COMPANY

New York • Tulsa
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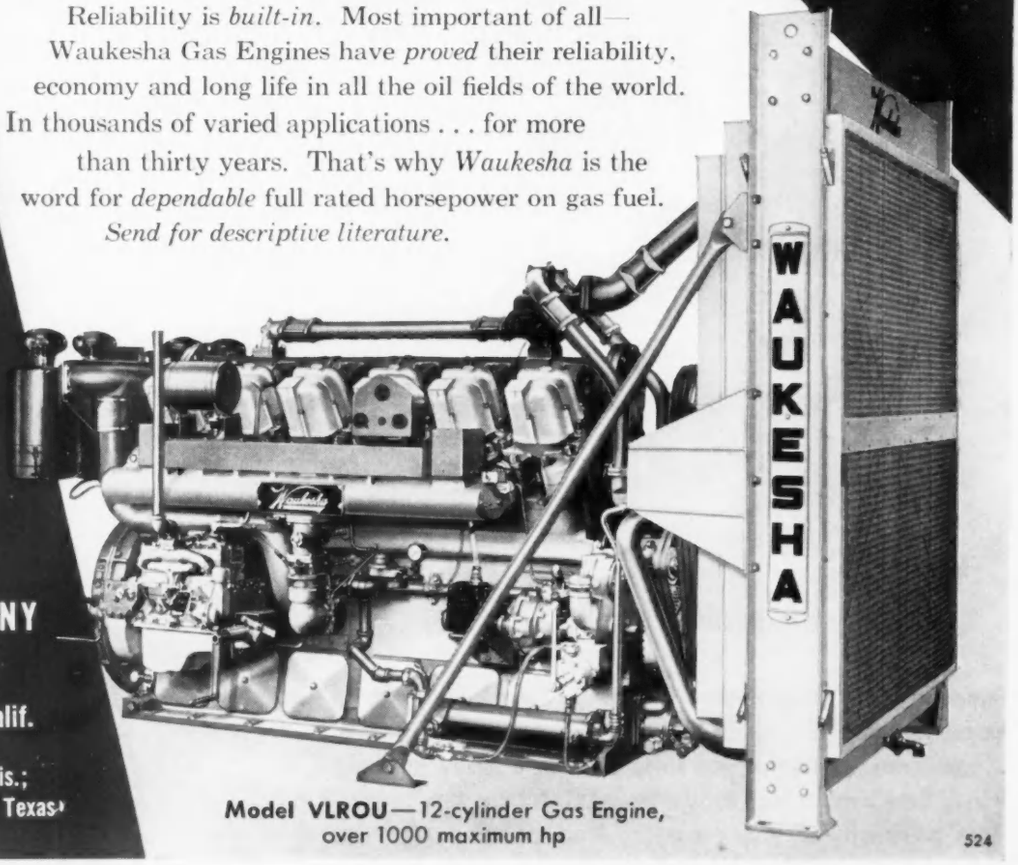
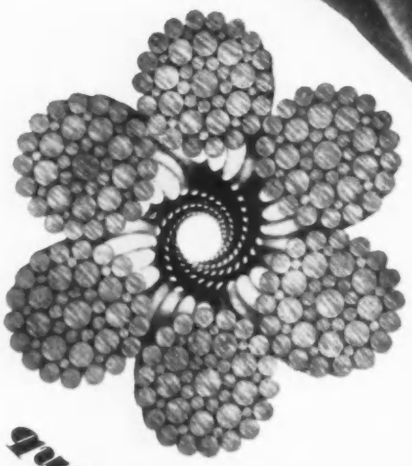
Factories: Waukesha, Wis.; Clinton, Iowa; Houston, Texas



Model VLROU—12-cylinder Gas Engine, over 1000 maximum hp

524

We put a lot of work into it — You get a lot of work out of it



quality inside and outside

Here are two "close-ups" of Roebling Royal Blue Wire Rope which show in part where your savings come from . . . uniformity of structure. Invisible, but equally important, is Royal Blue's *extra* high tensile strength. All the way through, Royal Blue pays off for you on every kind of wire rope job. Find out more from your wire rope distributor, or write for free booklet to Roebling's Wire Rope Division, Trenton 2, New Jersey.

ROEBLING

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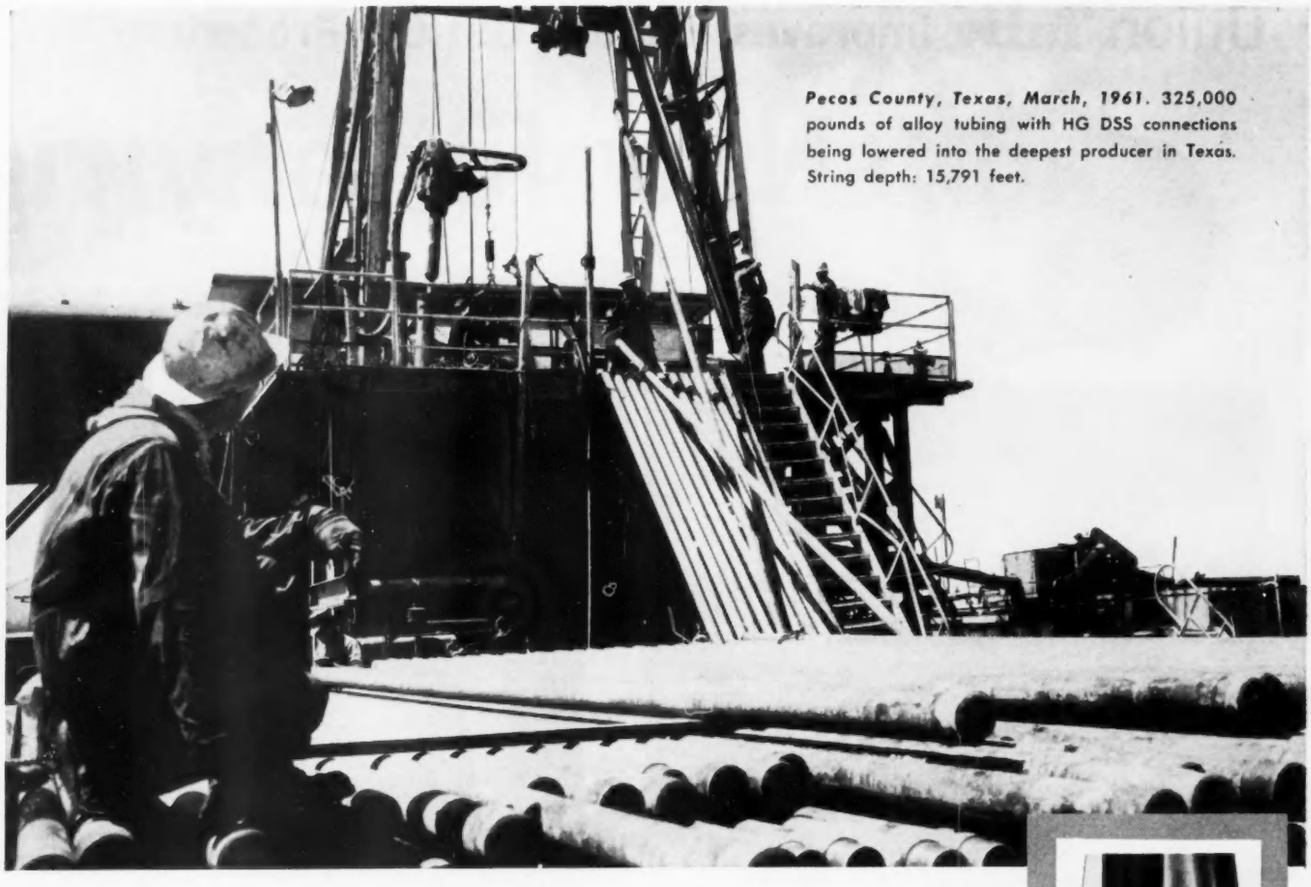
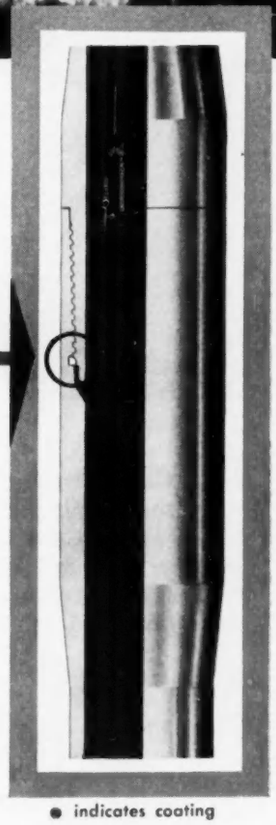
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation.



Pecos County, Texas, March, 1961. 325,000 pounds of alloy tubing with HG DSS connections being lowered into the deepest producer in Texas. String depth: 15,791 feet.

USED IN TEXAS' DEEPEST PRODUCER

HG DSS TUBING CONNECTIONS



TEFLON SEAL

Streamlined HG DSS joints are installed in Atlantic Refining Company's No. 1 J. C. Kelly well in Pecos County—the deepest producer in Texas. This combination of rugged design and Teflon* seal has earned the confidence of engineers using this connection. The seal, unaffected by temperatures to 500° F, prevents seepage of the most difficult gases. Chipping of plastic coating is avoided by the unique joint design and the placement of the Teflon ring.

For deep-well, high-pressure applications, specify HG DSS tubing connections. For less critical applications use the economical HG DS. To leakproof your API threaded joints, get HG GT-API dual seal couplings. Write for descriptive literature.

All HG connections available in Europe through Stewarts and Lloyds Ltd. (England) and Comptoir F.B.T. (France).

● indicates coating

ATLAS BRADFORD COMPANY

General Offices: 3600 Yoakum Blvd., Houston 6, Texas
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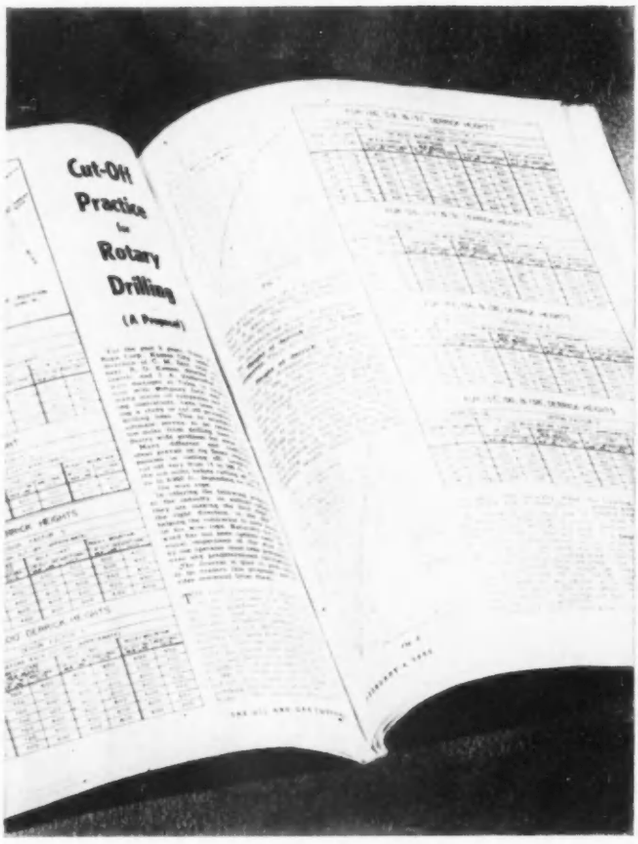
Formerly: Atlas Pipe Inc. / Bradford Supply Company / Hardy-Griffin Engineering Corp. / Universal Inspection & Service Co.

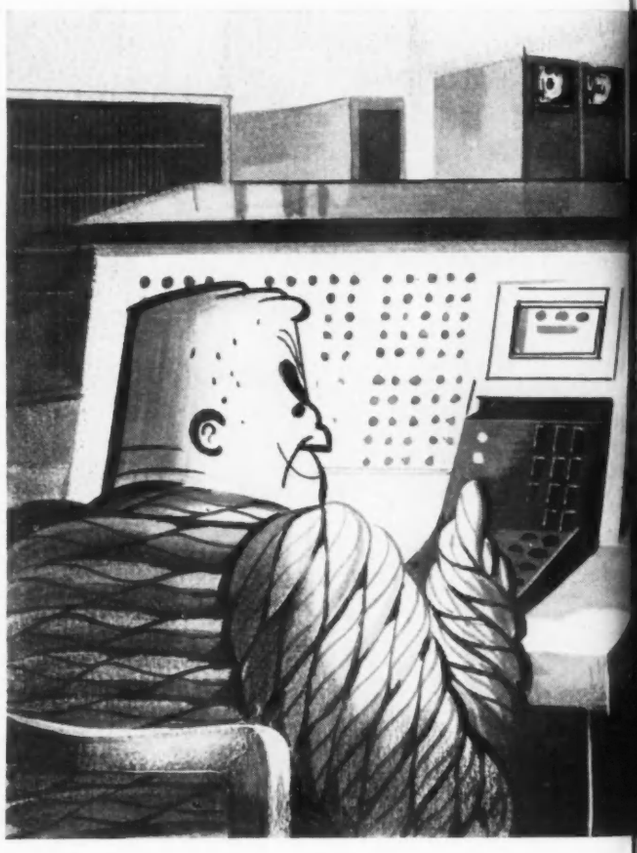
*Registered trademark of E. I. Du Pont Co. for their fluorocarbon resins including TFE resins.

Union Tuffy® Improves Famous Cut-Off Procedure!

Now for any rig a

Cut-Off Procedure Tables are Instantly Available Fron





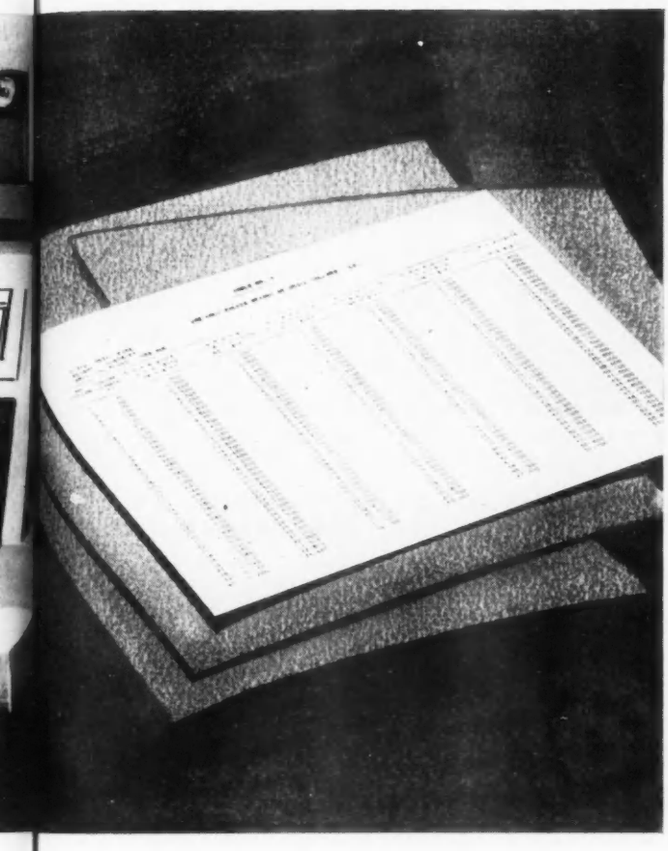
In 1952, after 3 years' work with company field men, major oil companies and drilling contractors, Union brought out the first workable cut-off practice for rotary drilling. It has helped contractors get more service and save money on wire rope and to avoid down-time and costly fishing jobs.

Electronic Brain, the IBM "705" has now been used to create Union's improved Electronic Cut-Off Procedure. It took 462 charts, with over 600,000 calculations, to cover all the variables. But now we have ton-mile charts that tell you the proper length and time to cut rope for maximum safe service for any drilling operation anywhere in the world.

Union Tuffy pioneers again. Using the same magic brain that it takes to get missiles and rockets off the launching pad, Union presents the next great advance in oil field wire rope cut-off procedure — an extension of the successful cut-off system which Union originated years ago. Union brings you this million-dollar service free. Try this improved Electronic Cut-Off Procedure on your next drilling operation. And be sure you specify Union Tuffy Standard Rotary Line, Union Tuffy Jackknife Rotary Line and the standard Union Oil Well Servicing Ropes. The best costs less on the long haul. For quick delivery, call your Union oil field supply store.

gany drilling situation

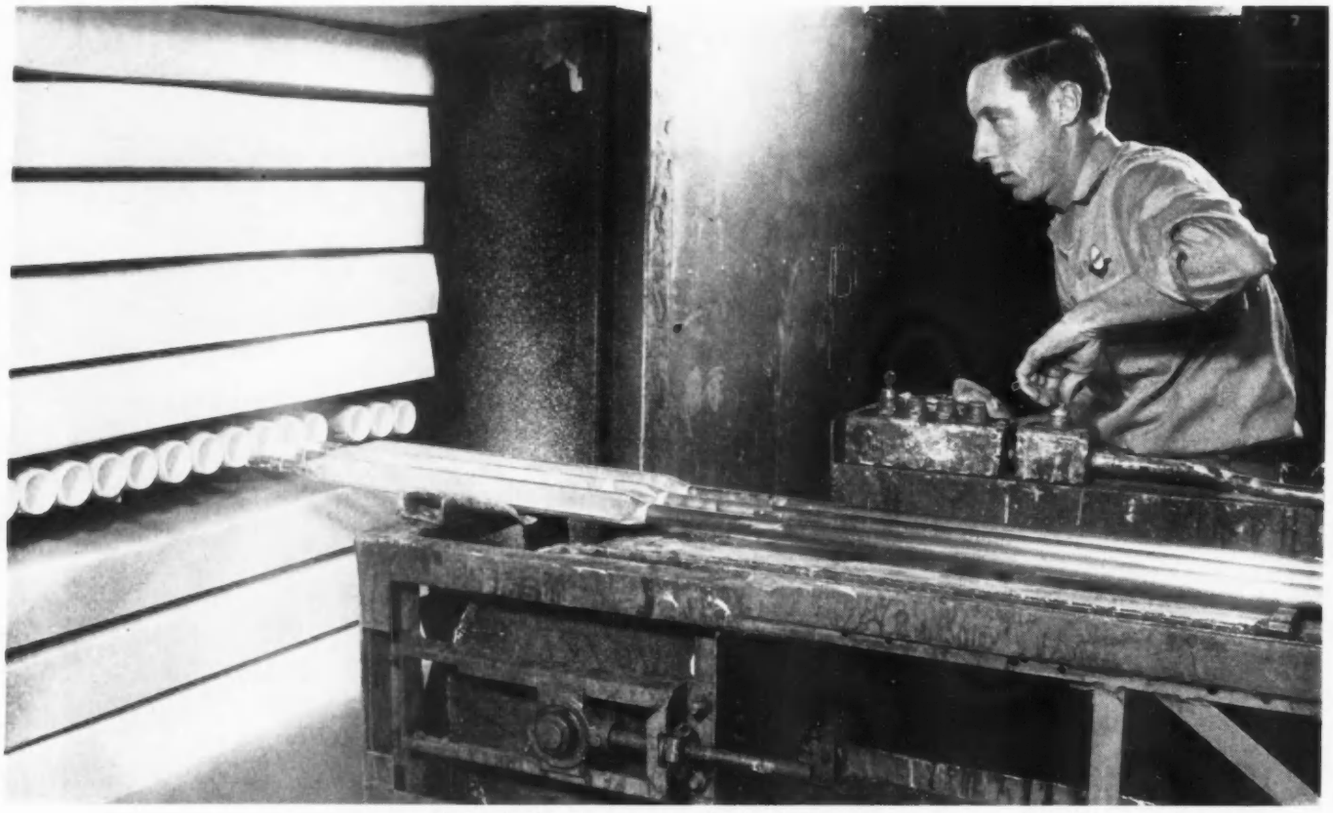
From 600,000 Calculations Made by "705" Electronic Brain



A Few Simple Charts are all you need—probably 5 or 6—to cover all your drilling operations. No great mass of figures to wade through. The whole Electronic Cut-Off Procedure is really simpler, much easier to use, more accurate. In fact, it is an electronic simplification of Union's own original cut-off procedure.

New Personal Field Service comes with Union's improved Electronic Cut-Off Procedure. Just outline your drilling plans. A qualified Union field man will bring the specific charts you need, and explain their use to you and your entire crew. **Write Union Wire Rope, Armco Steel Corporation, 2104 Manchester Ave., Kansas City 26, Mo.**

ARMCO **Union Wire Rope**



Plastic Applicators uses specially designed spraying lances to apply uniform plastic coatings.

Why do some pipe coatings outlast others?

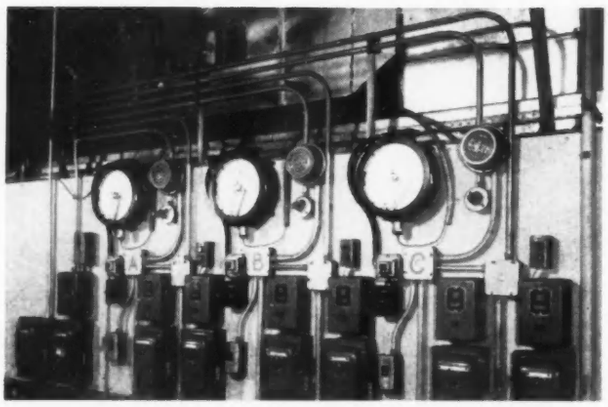
One reason is that some plastic formulations are superior to others.

Another less obvious (but often more important) reason is that some coating applicators use more effective application and quality-control methods than others. These better methods produce more durable coatings that make your pipe last longer.

At Plastic Applicators, we apply Plasticap coatings only to carefully sandblasted, metal-clean pipe surfaces, using the unique application equipment shown above. Plastic Applicators engineers designed these efficient spraying lances to apply consistently uniform plastic coatings to pipe placed in baking ovens. To prevent moving the pipe before each successive coating has been applied and baked, our engineers designed a special conveyor mechanism to move the lances from oven to oven.

Another part of the answer to effective quality control at the four Plastic Applicators plants is in the process-control equipment shown below. The optimum time and temperature for each baking cycle are precisely programmed by these control devices to produce exactly the same result each time an ovenload of coated pipe is baked.

You can put these important quality-control procedures to work for you by specifying long-lasting



Plasticap coatings for your pipe. Call your nearest Plastic Applicators representative today for prices and delivery schedules.

LOCATIONS:

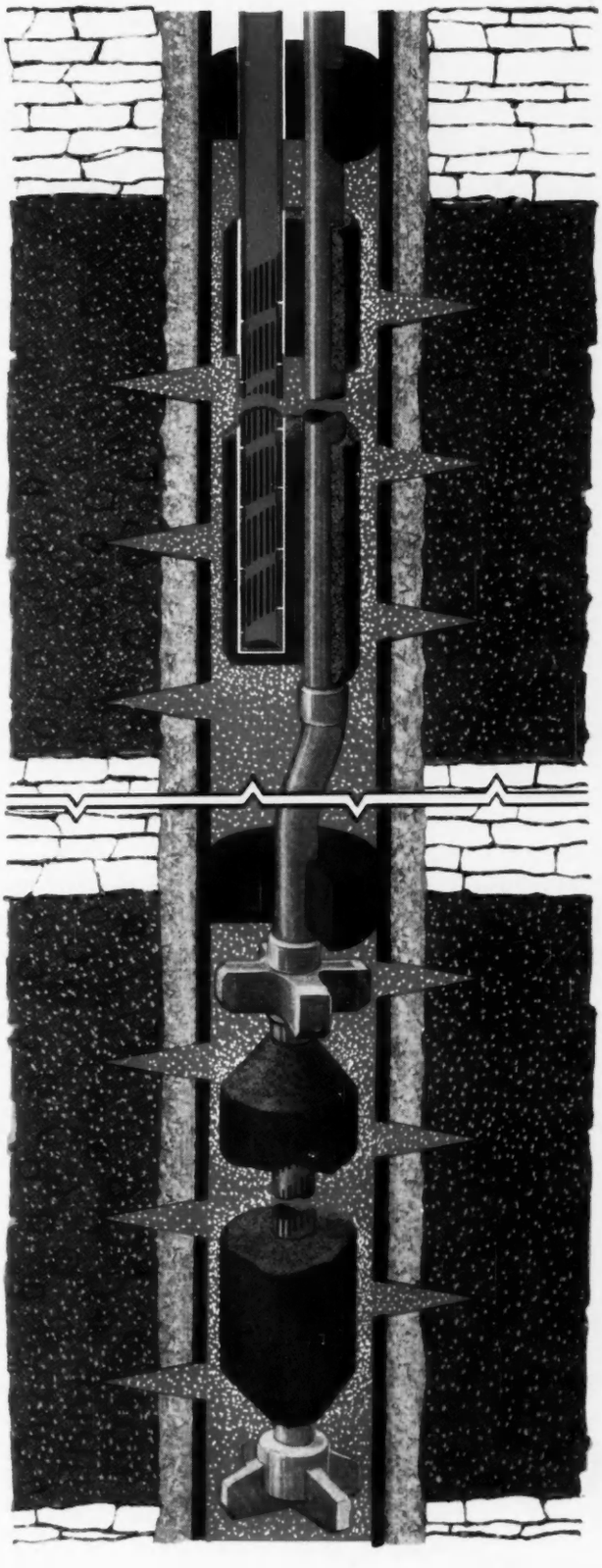
Main Office: *7020 Katy Road, P. O. Box 7631, Houston, Tex., UN 9-3611. Plants: Harvey and Morgan City, La.; Houston and Odessa, Tex.*

Sales Offices: *Midland and Corpus Christi, Tex.; Hobbs, N.M.; Tulsa, Okla.; Houma, Lafayette, New Orleans, and Shreveport, La.; Jackson, Miss.*

BETTER COATINGS THROUGH RESEARCH

PLASTIC APPLICATORS, INC.

SAND STOPPED! PRODUCTION INCREASED!



. . . this could be the story of your sand producing well when you install a HALLIBURTON SAND SCREEN

Halliburton Sand Screens help control fine sands from flowing or pumping wells in unconsolidated formations before they can enter tubing and damage pump and surface parts.

The mandrel of the Sand Screen is covered with a sheath of consolidated rounded Ottawa sand which serves as a natural buffer against produced sand. This tool is normally installed just prior to placing the well on production.

A specially-formulated resin bonds the sand grains together around a slotted tubing mandrel. This thermo-setting resin provides as much as 3,000 psi compressive strength and from 800 to 1,000 psi tensile strength — while retaining permeability of more than 40 darcies. Halliburton designed the Sand Screen to operate effectively in temperatures as high as 300° F. depending upon bottom hole conditions.

Halliburton Sand Screens are six feet in length. For single tubing strings, sizes are manufactured for 4½" and larger casing. Available for multiple as well as single string installations.

For extremely severe sand problems, see your Halliburton man for full details—and your copy of the new booklet: "Halliburton Methods of Sand Control."

275 Service Centers

. . . just minutes away from your well!

PRODUCTION TOOLS

Halliburton
COMPANY · DUNCAN OKLAHOMA

For more data on advertised products, use cards, last page.

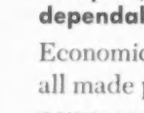
Guess what made this waterflood pay off!

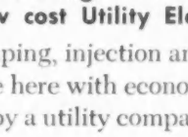
Compact, efficient design and above all . . . dependable, low cost Utility Electric Power!

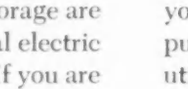
Economical pumping, injection and storage are all made possible here with economical electric power supplied by a utility company. If you are planning a waterflood or simply modernization of your existing producing fields, it will pay you to investigate the many advantages of purchased electric power. Consult your nearest utility electric power company today!

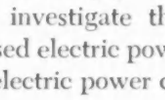
Petroleum Electric Power Association

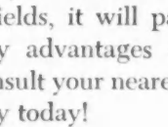
P. O. Box 35006 • Dallas 35, Texas











List of P. E. P. A. members will be furnished on request.

The move to Autocar is

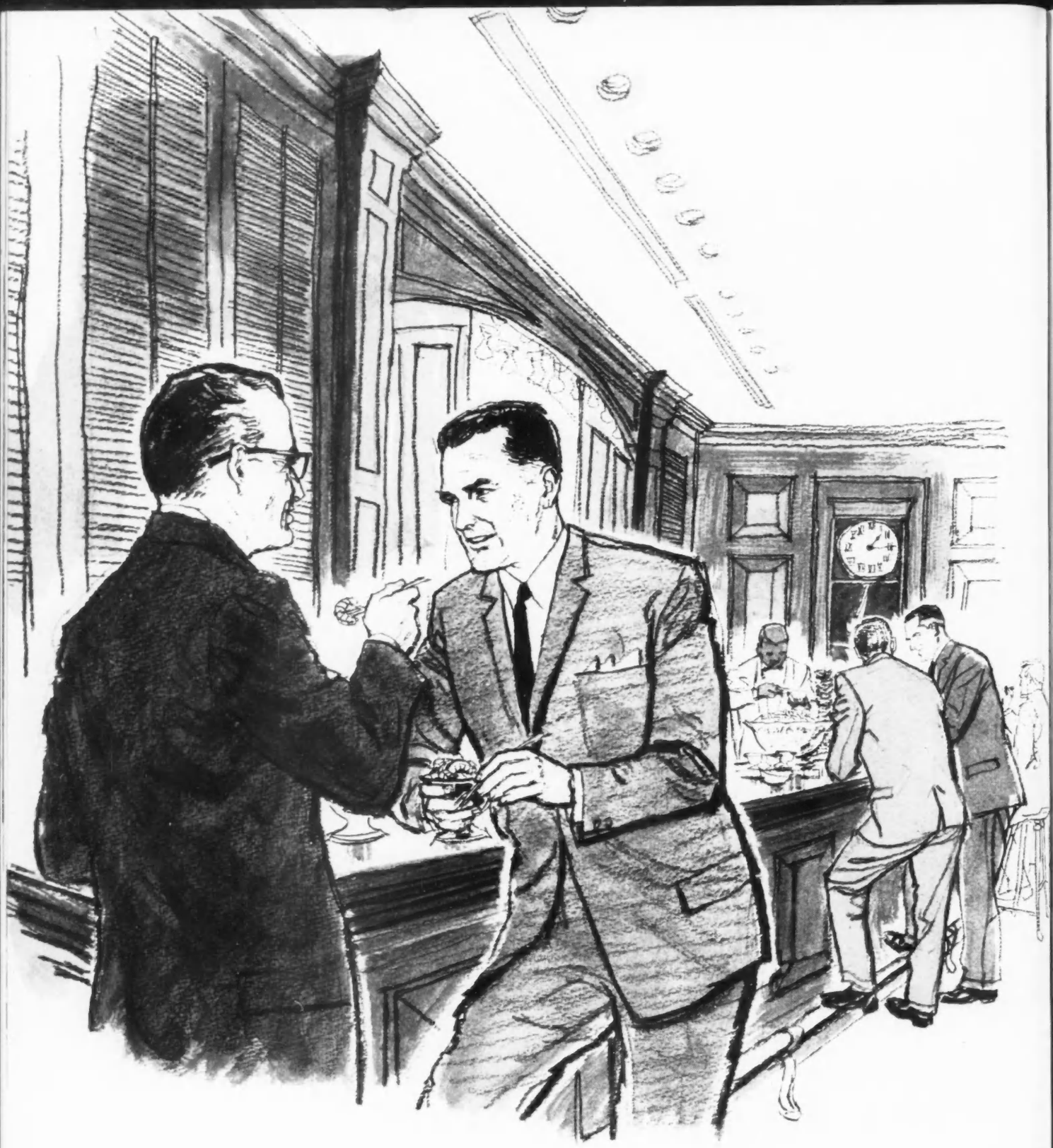
no ordinary experience

This extraordinary experience *usually* starts with some hard-headed figuring about the dollars-and-cents payoff. But the day a truck operator takes possession of his Autocar, emotion takes over. His chest swells. Like the man with a new Browning Grade IV shotgun, or a custom-made fly rod, or a Rolls-Royce car, he knows that now he owns the finest. And he knows the respect his new acquisition will command from others. For Autocar says he has arrived!

Why settle for less when nothing takes the place of owning the "World's Finest." Aren't *you* ready to join the Autocar fraternity?

Autocar
"World's Finest"

Division of
The White Motor Company
Exton, Pa.



"Things are really looking up since we moved our account to Bank of the Southwest. They helped us increase our returns from our oil and gas properties."

"They're our bank, too. Their officers understand the problems of the oil man."

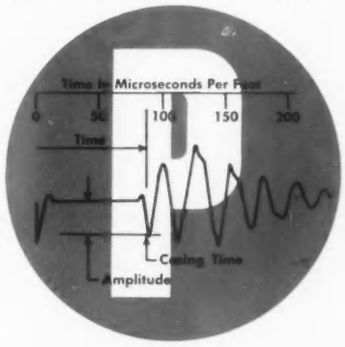
Bank of the Southwest
NATIONAL ASSOCIATION, HOUSTON
Member F. D. I. C.

OSCILLOGRAMS OF THE SATA CEMENT LOG
As seen in PGAC's logging units

Casing Velocity = 17,500'/s or 57 μs/ft.

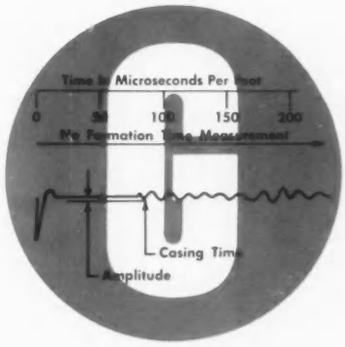
HOW SATA CEMENT LOG
TRADE-MARK

checks casing cement jobs



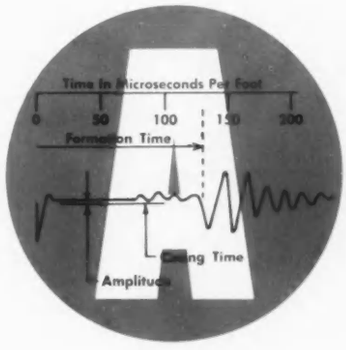
UNCEMENTED CASING SIGNAL

Both tracking pulses are logging strong casing signal. No cement bond to casing. Note casing velocity.



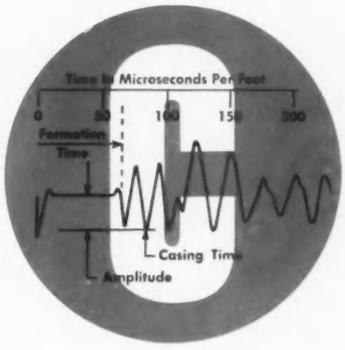
CEMENTED CASING SIGNAL

A very weak casing signal is recorded by the amplitude tracking pulse at casing velocity. When the signal amplitude is too low to trigger the tracking pulse, no time measurement is made. Cement is bonded to the casing but not to the formation.



CEMENTED TO BOTH CASING AND FORMATION

Amplitude tracking pulse remains at casing velocity and records very weak signal. Single receiver tracks stronger formation signal. Formation has lower velocity than casing.



CEMENTED CASING IN HIGH VELOCITY FORMATION

Single receiver tracks strong formation signal which reaches receiver before casing energy, and the casing signal is overridden. A strong formation signal can only be received when good Acoustic coupling exists between casing, cement, and formation.

PGAC-612

PAN GEO ATLAS CORP.

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Ni-Resist impellers and bowls in a pump similar to the one shown above helped raise production 500% in the Miles Lease (Dawson Field, Richardson County, Nebraska).

How Nemaha Oil Company increased production 500% with pump using Ni-Resist*

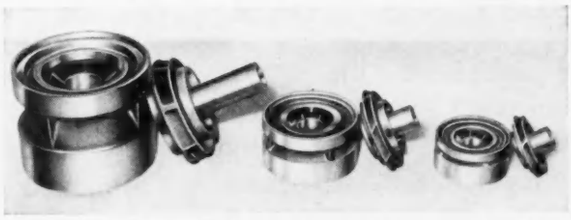
In a Nemaha Oil Company lease, a large water drive, accompanied by corrosion, made Miles C-2 a costly operation; in fact, most of the wells surrounding the Nemaha property had been plugged and abandoned.

Within two months of installing a "Centrilift" pump, production rose 500%. And Ni-Resist Alloy helped to make this possible: in the former pump, corrosion-erosion had quickly knocked out cast iron parts handling 20 bbl/day of oil and 700 barrels of water. But Ni-Resist impellers and bowls are giving long service life—handling 110 bbl/day of oil and 3400 barrels of water.

"The build-up of carbonates, sulphates, and other materials does not occur rapidly on Ni-Resist," reports Byron Jackson, Inc., a manufacturer of the "Centrilift." Excellent corrosion resistance to salt water, brine, sour crude, and many salts prevents Ni-Resist irons from readily pitting, greatly inhibiting deposition.

In resisting wear in the bearing area and withstanding erosional wear, Ni-Resist has several times the life of cast iron or bronze. This holds true in both sand-laden and clean fluids, "Centrilift" users report.

A 70-page booklet gives more information on how the Ni-Resist irons, readily cast and machined, give such an excellent combination of corrosion-erosion resistance and wear resistance to deep-well pumps, brine pumps, valves, and piping. A post card will put "Engineering Properties and Applications of Ni-Resist" on your desk. **Registered trademark*



Type I Ni-Resist impellers, shown above, are standard equipment in all BJ "Centrilift" pumps. Their excellent corrosion-erosion resistance to oil-field fluids means long service life and little downtime.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO

NI-RESIST

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

For more data on advertised products, use cards, last page.

They've both got a "business end"

In a pistol it's the muzzle . . . and in oil country tubular products it's the threaded connections. This is a vital area that helps determine performance "life-or-death." And it's here that CF&I Seamless Casing and Tubing really has what it takes for success.

Every thread is cut by modern machinery – then checked by a contour microscope that determines absolute accuracy of angle and form. No weak links survive to render hundreds of feet of pipe worthless.

In short, CF&I Casing and Tubing holds up on the job, but never holds *you* up on the job. It's available in sizes from 2⅜" to 9⅝" O. D. and meets API specification STD 5A. Ask your CF&I salesman for complete details.

8232

The Colorado Fuel and Iron Corporation
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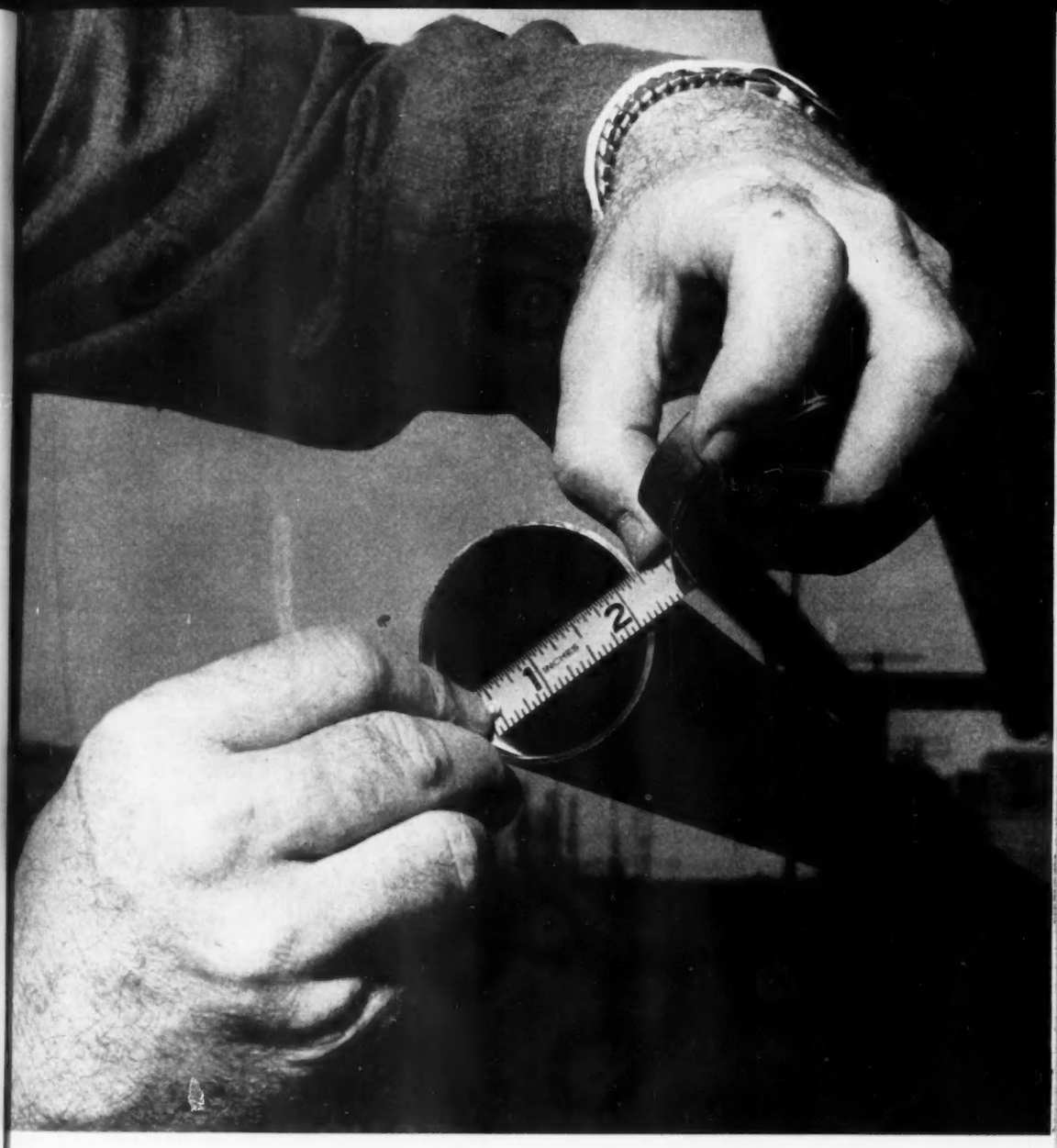

1 13/16" Wilson F. J. Drill Pipe (Left Hand)
Cross Over Bushing (Left Hand)
2 7/8" EUE Tubing
Die Collar (Left Hand Catch & Connection)
2 1/4" Wilson F. J. Washpipe (Left Hand)
Fish
2 1/4" Rotary Shoe

NEW from Wilson Supply Fishing Tool Division

2¼" O. D. Flush Joint Washpipe

The Engineering Research and Development group at Wilson Supply Fishing Tool Division has come up with the answer for operations inside tubingless completions and small diameter pipe with its new 2¼" O.D. Flush Joint Washpipe. And this rental pipe is available with either right-hand or left-hand threads. Left-hand threads make it possible to washover, back-off and retrieve — all in one operation.

All the handling tools for the right- and left-hand strings are available, too . . . Taper Taps, Subs, Lift Plugs, Safety Clamps, Rotary Shoes and the Wilson PS-70 Power Swivel can provide the rotary power for this new 2¼" Washpipe.

For the latest in fishing tool equipment . . . for the best in service, call your Wilson Supply Fishing Tool Service Point. They have the men and the tools to handle your job *quickly . . . safely!*

WILSON SUPPLY CO
HOUSTON, TEXAS

1301 Conti Street, P. O. Drawer 19, Houston, Texas
International Division
1301 Conti Street, Houston, Texas
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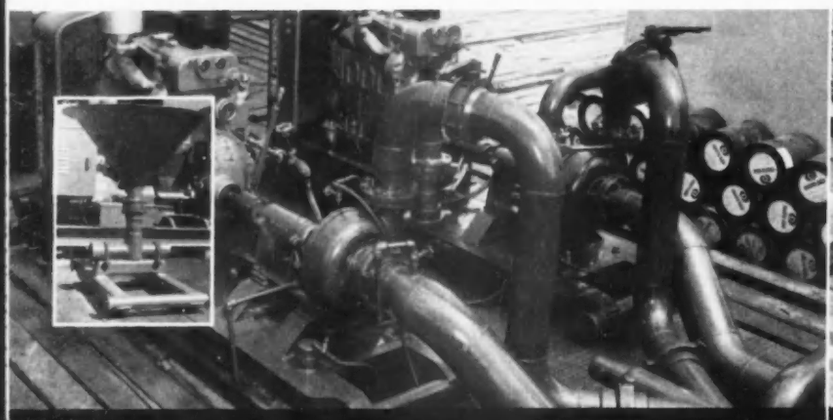
Our 40th Year of Service to the Petroleum Industry

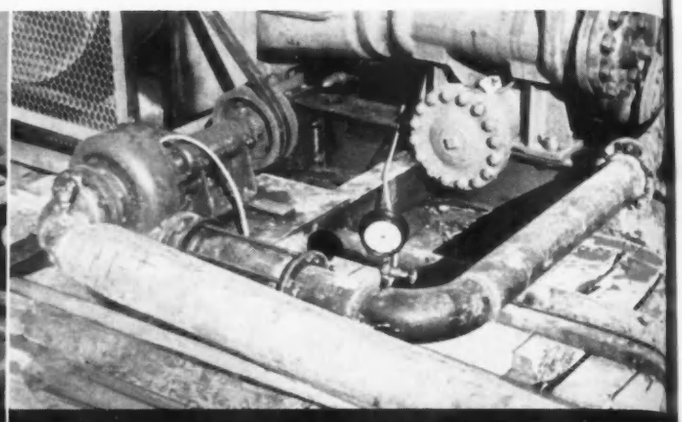
Oil & Gas Supplies • Tubular Goods • Production Equipment • Drilling Machinery • Packaged Compressors • Fishing Tools

6113

Mission centrifugal pumps for oilwell drilling rig service

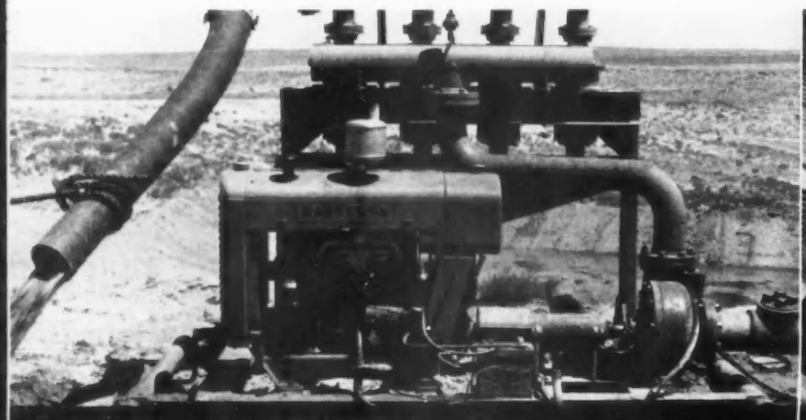


MUD PROCESSING — Large volume capacity permits fast, uniform rolling for mixing and treating. Permits rapid addition of lost circulation material when using the special Mission Mud Mixing Hopper.

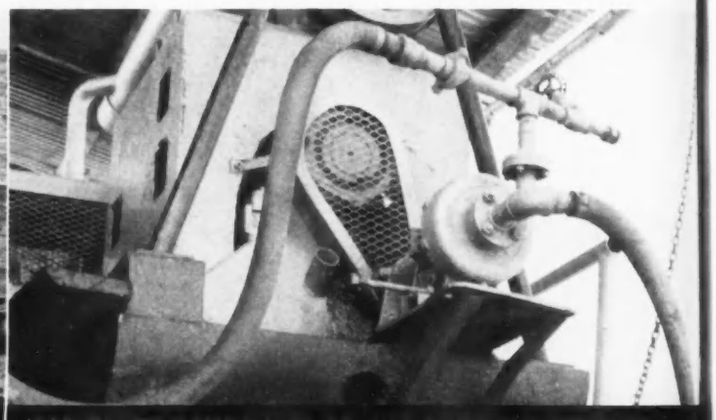


MUD PUMP SUPER-CHARGING — Keeps mud pump at peak efficiency. Prevents mud pump from knocking. Increases mud pump volume when mud is air or gas cut.

originally designed for the most rugged rig applications afford



DEGASING AND DESANDING — Mud volume and mud pressure effectively operates degaser and desander equipment.



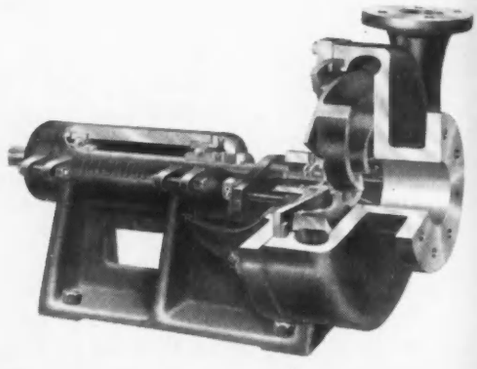
RIG WASH-DOWN AND BRAKE COOLING SERVICE — Provides large volumes and adequate water pressure for economical safe operations.

longer service, easier maintenance, trouble free operation–

Mission Concentric Casing With Streamlined Flow

Conventional Casing With Turbulent Flow

MISSION CENTRIFUGAL PUMPS LAST LONGER, WORK BETTER — Streamlined flow is obtained in the concentric casing, because the restriction at the discharge as found in the conventional casing has been eliminated. This design minimizes wear and maintains rated output longer under difficult abrasive and corrosive conditions.



even in highly abrasive service

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OVER THIRTY YEARS OF DRILLING RESEARCH

OIL CAMPS like this one, comprising offices, 2 and 4-berth quarters, refrigerated and commissary stores, power house, laboratories, workshops, radio unit, messes, club/bar, dispensary and sick bay—all completely equipped and fully mobile on skids, trailers or trucks—are designed and built by

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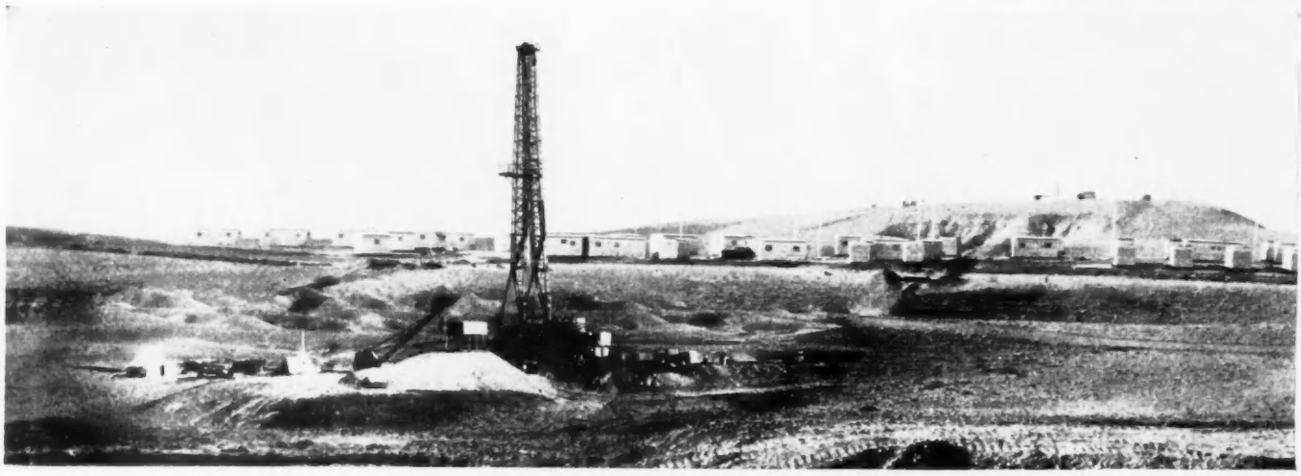

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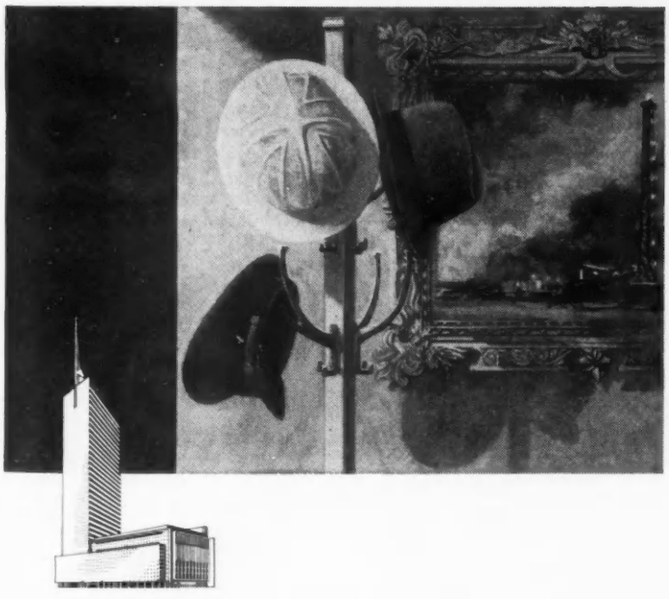
R H I A

RANK HAS ITS ADVANTAGES



For decades, oil and gas men have turned to the Republic for the many varied and special bank services they require. Republic knows you must have accurate fact and figure data, prompt desisions on financing, and frequently, bank counselling with your lawyer on regulations and tax matters.

As a pioneer oil bank in the South . . . with the South's largest Oil and Gas Department, Republic is uniquely equipped by experience, knowledge and resources to give you the complete, specialized service you need.

Doing business with Republic Bank indeed has its advantages and they are in your favor. Next time, talk Republic, indisputably a leader in the field of oil and gas financing. We're here to serve you.

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CAPITAL AND SURPLUS $105,000,000 ★ LARGEST IN THE SOUTH

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

"It's Dependable," says West Texas Contractor using Bethlehem Wire Rope. These servicing units are in the yard of Hoffman Oil Well Service Company, Seminole, Texas. D. G. "Pappy" Hoffman, shown in the picture, specifies a considerable amount of Bethlehem Wire Rope on much of his servicing equipment. For example, each of the units shown contains more than two miles of Bethlehem 6 x 7 solid-plastic core line, and about 500 ft of Bethlehem 18 x 7 non-rotating rope. "We get good performance from Bethlehem rope," said Mr. Hoffman. "It's dependable, and we can't ask for more than that."

Steel

There's a distributor of Bethlehem Rope near you, supplied by our nationwide network of wire rope mill depots.

Bethlehem Steel Company, Bethlehem, Pa. *Export Sales:* Bethlehem Steel Export Corporation

for Strength ... Economy ... Versatility

BETHLEHEM STEEL

BETHLEHEM WIRE ROPE

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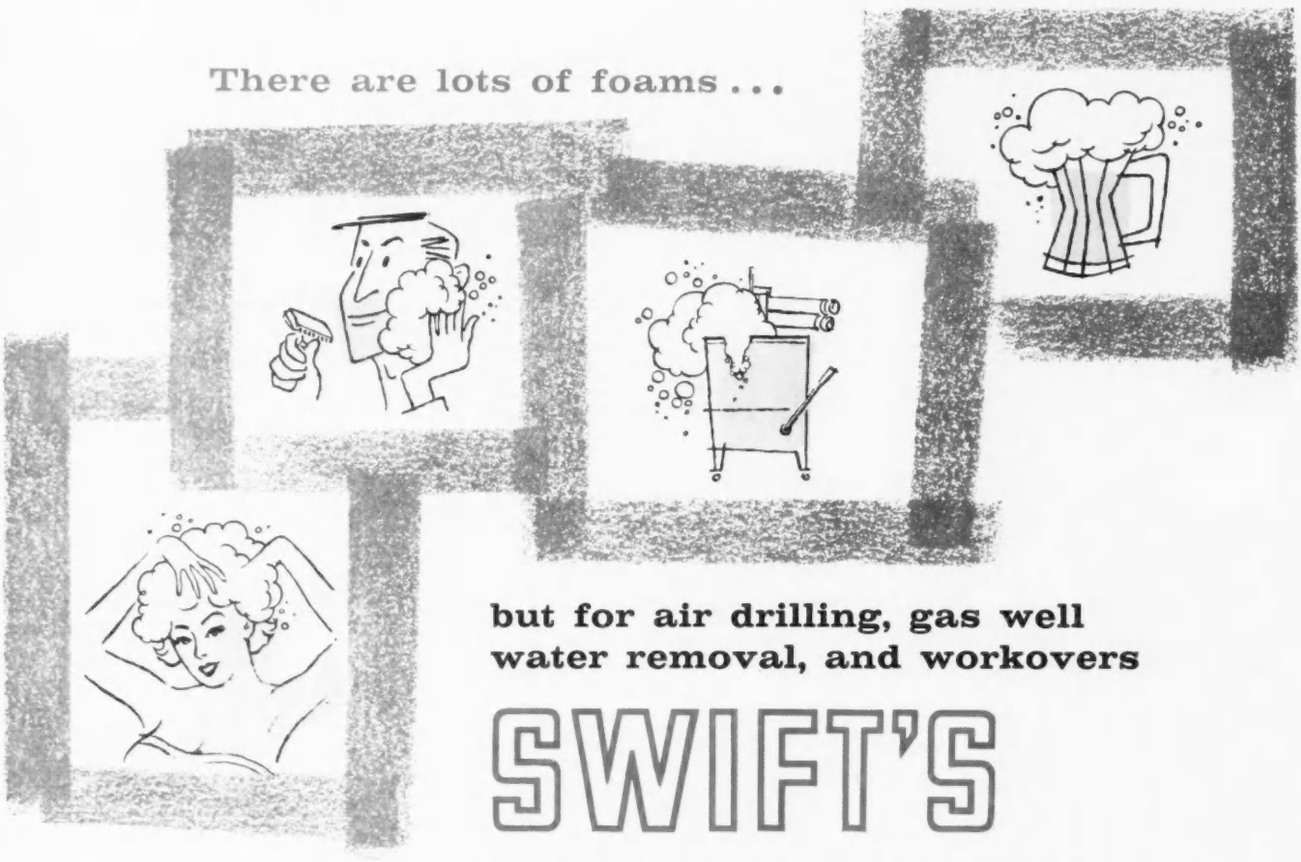
There are lots of foams . . .



but for air drilling, gas well water removal, and workovers

SWIFT'S SYNFOAM

gives you these four most important characteristics

1. The ability to remove large volumes of water—optimum bubble thickness and water entrainment.
2. Low adsorption on cuttings for more economical usage. Helps in unloading a hole after losing circulation during trips, etc.
3. The ability to work in the presence of salts of all kinds for greater efficiency under tough conditions.
4. The flexibility and toughness to withstand extreme air velocities encountered when air is the circulating fluid.

Swift's Synfoams have been developed especially for oil field usage with the characteristics *you* need built in. And they are easy and economical to use wherever foam is needed. Ask your Synfoam distributor for full information or write

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FOAMING AGENTS
106TH YEAR
To Serve Your Industry Better

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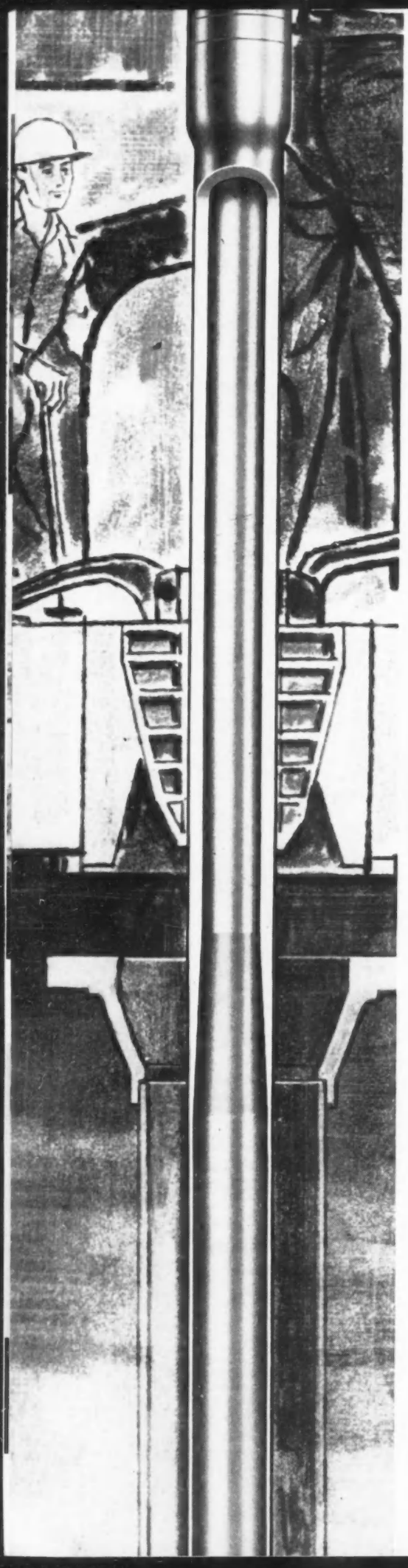


PITTSBURGH STEEL REPORTS ON...

DUAL WEIGHT DRILL PIPE

SUCCESS IN FIELD TEST

In West Texas, South Louisiana, Oklahoma and out on the West Coast, Pittsburgh Steel Company's new Dual Weight Drill Pipe is proving itself the way drillers best understand—by performance under actual field conditions.

Dual Weight is a completely new type of drill pipe developed and produced exclusively by the manufacturer of "Pittsburgh Seamless."

It provides drillers an integral combination of strength and light weight never before available in popular API grades and sizes of drill pipe.

Drilled footage on four strings of Dual Weight now stands at better than 100,000 feet—every inch of it under normal rotary drilling practices.

Results? Excellent—better than expected in some cases.

Field tests are continuing. Additional strings are being placed in service on drilling operations specifically selected to prove out Dual Weight's advantages and performance under the widest possible range of drilling conditions.

But, so far, here's what experience shows Dual Weight does:

- Cuts drill string weight.
- Increases rig depth capacity.
- Increases slip area strength up to 20 percent.
- Boosts hydraulic performance.
- Effects lower maintenance costs and longer service life on rig equipment.
- Cuts transportation costs.
- Increases drilling rates and speeds up round-trips.

• **What is Dual Weight?**—First of all, it's one of the most important developments in rotary drilling in many years. It's an entirely different type of drill pipe design—although it looks the same as other drill pipe. The difference is in the ID.

Look at the cutaway sketch at the left of this page. It shows Dual Weight's design features.

Notice the box end. Below the tool joint and upset, it has at least four feet (but not more than six feet) of heavy wall steel in the critical slip area. Then, a gradual, uniform internal taper makes transition to a light wall body that extends the remainder of the joint's length.

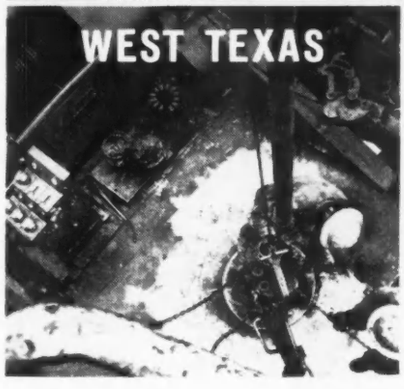
Some drillers refer to the heavy wall at the box end as a "long upset"—a good description, but inaccurate. The heavy wall is produced

by a patented process that bears no resemblance to upsetting.

Drillers can benefit two ways with Dual Weight.

If it's a lower hook load they want, then thin wall Dual Weight meets the need. It combines the strength of standard pipe in the slip area, and the weight saving of lighter weight pipe in the body.

Or, if extra strength and safety—rather than lower weight—are required, Dual Weight again is the answer. In this version, it has a standard wall body and an extra heavy box end with a safety factor

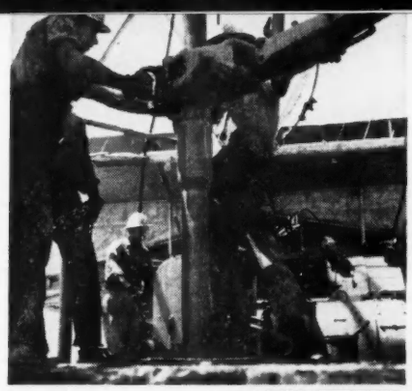


near or equal to the safety of the body.

• **Strength?**—Either way, Dual Weight has it—in the slip area where it's needed to resist the notching, crushing, crimping, stretching and bending forces it is subjected to.

Light weight? Its thinner wall body eliminates pounds per foot over 85 percent of the length of a 30-foot joint.

For example, 4½-inch Dual Weight with a .337/.254-inch wall weighs 16.60 lb./ft. for 15 percent of its length (the box end) and 13.25 lb./ft. for 85 percent of its length (the body).



And don't overlook hydraulic performance. The larger ID resulting from Dual Weight's thinner body wall lets pumps push more mud at lower pressures. There's more energy applied at the bit. Penetration rates are higher and returns are better.

But here's a sample of how drillers themselves benefit from Dual Weight.

A Large Independent Oil & Gas Drilling Corporation—drilling shallow wells in West Texas with 6,000 feet of 4-inch (.330/.254-inch wall) Grade E Dual Weight.

A Drilling Superintendent—"I believe Dual Weight is the only thing for a little rig. Its lighter weight means less wear and tear on the rig and equipment. And when you move as often as we do, there's quite a saving on trucking charges. Any time we can get away from handling weight, we're better off."

A Veteran Tool Pusher—"We save trip time because we can come out of the hole faster. With less weight we get more rpm's. We save fuel, too, because our engine isn't working as hard."

• A major oil company, drilling deep wells in Louisiana with 15,000 feet of 4½-inch, (.337/.271-inch wall) Grade E and P-95 Dual Weight.

A company drilling engineer said: "We're looking for higher velocities and larger volumes of fluid at equal pump pressures from Dual Weight. We know we're getting better hydraulics—moving more fluid.

"In deep drilling with high mud weights, you get better penetration with increased bit hydraulic horsepower. We calculate we're getting a 25 percent increase in BHP."

Interested in more detailed information? Write for literature, or contact a Pittsburgh Steel district sales office or one of the independent distributors listed below.

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ADDITION AGENTS are available to reduce surface tension, prevent or break emulsions, remove or prevent the formation of compounds that might plug the formation, and speed up or slow down acid reaction with the formation.

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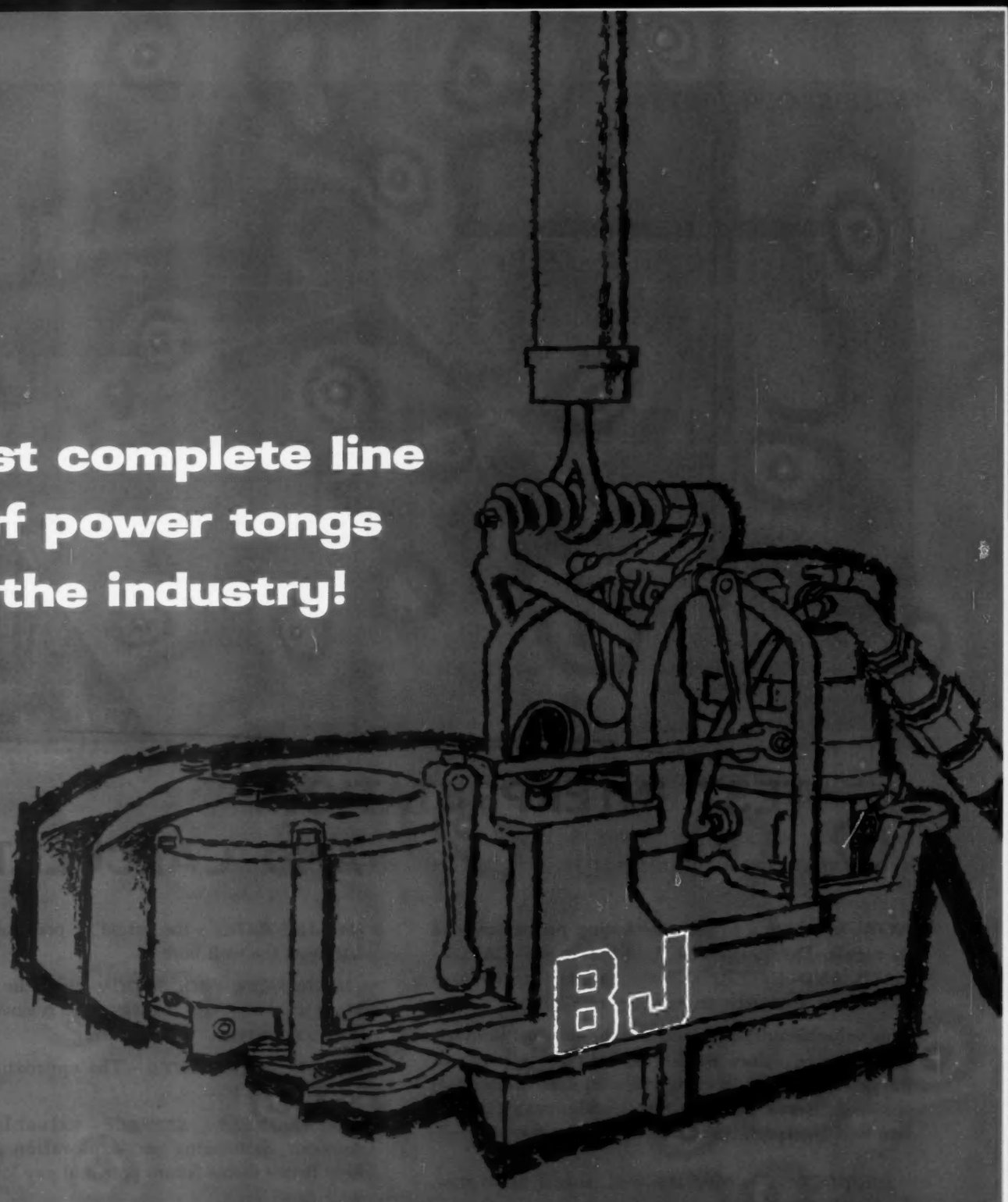

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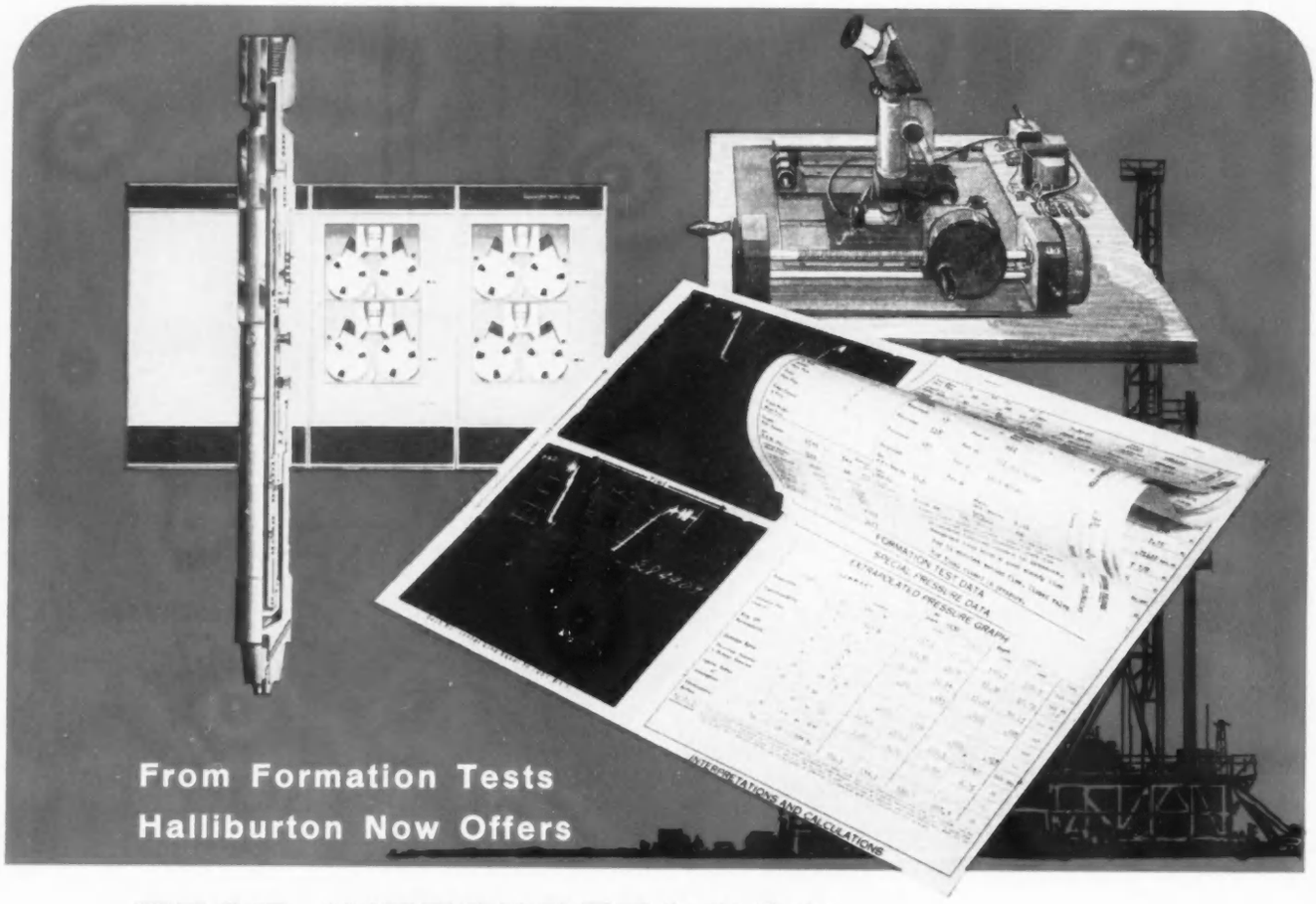

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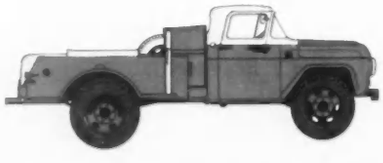

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NEWEST TECHNIQUES AND PRACTICES

Still caught in a web of mounting costs, dwindling supply of efficient personnel, inadequate returns on invested capital, and continued primary emphasis by some operating companies on price alone, the drilling contracting industry has a host of problems it must solve before it can regain the healthy status it previously enjoyed.

One avenue toward solving at least some of these problems lies in contractors adopting the newest techniques and practices which have proved themselves from both operational and economic standpoints.

For that reason, WORLD OIL is presenting on the following pages, four of the newest proven techniques designed to save time, manpower and money.

Reduced substructure increases rig mobility
Page 116

New substructure design allows engine and drawworks to be located 5 feet off the ground and 11 feet below the derrick floor.

How to predict diamond bit drilling costs
Page 122

A new method of diamond bit evaluation, provides a quick and accurate means for comparing diamond bit drilling costs with cost of other drilling methods.

Engineered hydraulic program reduces drilling costs
Page 126

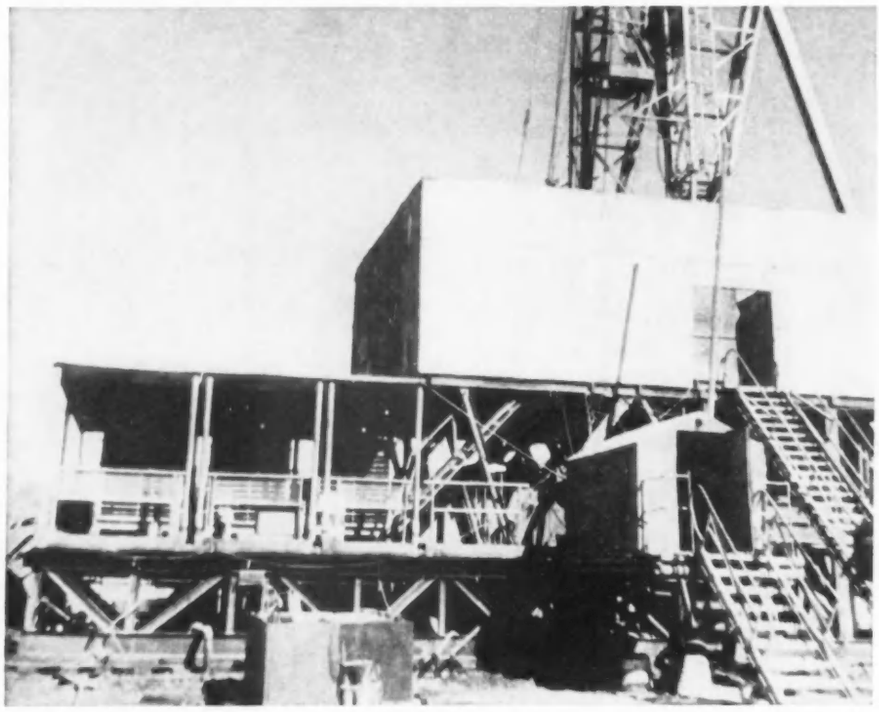
Drilling industry in California shows how penetration rates are increased and drilling costs decreased with supervised engineering hydraulic programs.

New wellhead assembly saves rig time
Page 132

Blowout preventers can now be installed on the conductor pipe and do not have to be removed until installation of the tubing hanger and conventional tree.

Jack F. Earl

ENGINEERING EDITOR



1 Delta Drilling Company's new Rig 4, redesigned to meet demands imposed on drilling industry today.

Reduced substructure increases rig mobility

This standard rig was redesigned to allow for engines and drawworks to be located 5 feet off ground and 11 feet below the derrick floor

By Edward G. Durrett
Vice President,
West Texas-New Mexico Division, and
Bobby R. Payne
Engineer Trainee-Driller,
Delta Drilling Company,
Odessa, Texas

DELTA DRILLING COMPANY, Tyler, Texas, recently designed, engineered and assembled a unique drilling rig which has drilled its first hole for Cities Service Oil Company, on the Henderson "B" 1, in Crockett County, Texas.

To meet demands imposed on the drilling industry today, Delta Drilling Company redesigned its old Rig 4 into a new concept of a drilling rig. Figure 1 shows the newly designed rig.

The following changes and results were observed from this new rig design:

- Jackknife derrick used instead of the standard derrick
- Engine and drawworks on the same level only 5 feet off the ground and 11 feet below the derrick floor
- Derrick floor offers greater safety working environment
- Installation of engines and drawworks do not require a high, steep ramp
- Rig-up time is decreased
- Rig can be skidded from one location to another in one complete unit.

Rig design. Basic design features of the rig include a 16-foot substructure on which is located only the derrick, rotary table, driller console, catshaft and related equipment such as tongs, etc. The rig contains a lower level substructure 5 feet high on which is located the drawworks and motors. The rig is designed to satisfy drilling depths of 14,000 feet, rated capacity of the derrick.

The substructure is composed of four parts using I-beam and wide-flange construction. The lower part of the substructure was newly fabricated and consists of a portion 8 feet high that supports the upper substructure and derrick. One portion of the lower part of the substructure is reduced to 5 feet and supports the engines and drawworks. The upper part of the substructure was modified from an older substructure. This part is 8 feet in height and rests on top of the 8-foot portion of the lower part of the substructure.

New vertical diagonal bracing was added to the older substructure to meet loading requirements. The four separate parts of the substructure are joined together by pinned cross members. There is clear working space of 13 feet between the outer portions of the substructure to permit better working conditions around the blowout preventer equipment.

The rotary beams are designed to accommodate four height adjustments required for different blowout preventer arrangements. The rotary is driven from the drawworks and eliminates the use of a rotary chain guard on the derrick floor.

The catheads have been located directly above the drawworks (Figure 2). A unitized cathead shaft is built in a pinned section (Figure 3) and is braced to eliminate movement. The new design is considerably shorter than the original catshaft which now is a counter shaft used to drive the new catshaft with a 2-inch single-pitch chain. This unit was built with a minimum of expense since the cat-

heads and related equipment on the original catshaft were utilized.

The entire unit can be moved without disassemblage other than removal of the pinned bracing and drive chain. The distance between catheads has been reduced considerably not only to provide extra working space, but also to establish safer working conditions.

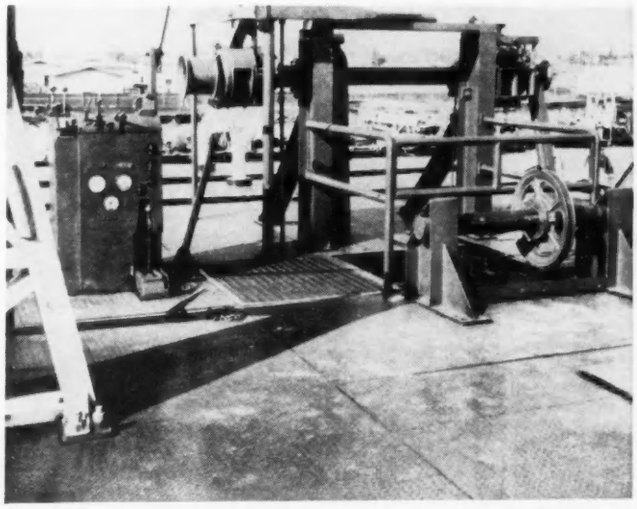
The driller console was added to the derrick floor with ease. The original console was removed from the drawworks and placed on the derrick floor (Figure 2) at a position that provided greater freedom to the driller as well as greater safety for the driller and crew. The position of the component parts of the console has been retained. The air components of the console are connected at a manifold on the drawworks which provides quick connection or separation. The gear shift to the drawworks has been retained for manual operation through a simple system of levers.

For the brake handle to be installed in a proper position beside the console, the original shaft of the old brake assemblage was extended 4 feet. The brake handle was connected by a system of clevises and levers which were joined by a 1½-inch shaft. This retained a manually operated brake with the original safety design at a minimum of expense.

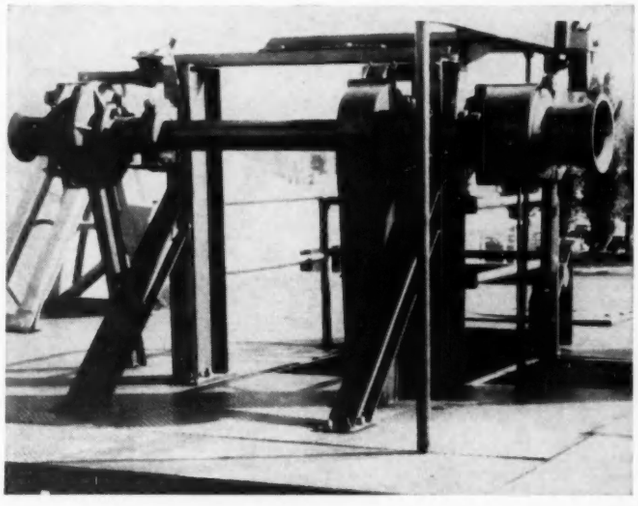
The position of the console with respect to the working floor area, derrick, and catshaft provides a maximum of safety (Figure 2). The driller has a clearer view of operations and is now relatively safe from falling objects, breaking tong lines and chains, and mud from the pipe.

When climatic conditions dictate winterization of the rig, considerable money can be saved. Working floor area is enclosed with panels that are easily installed and there are no obstructions to be encountered. Engines and drawworks may be enclosed with little material and/or labor (Figure 4). Engines and drawworks are presently under cover.

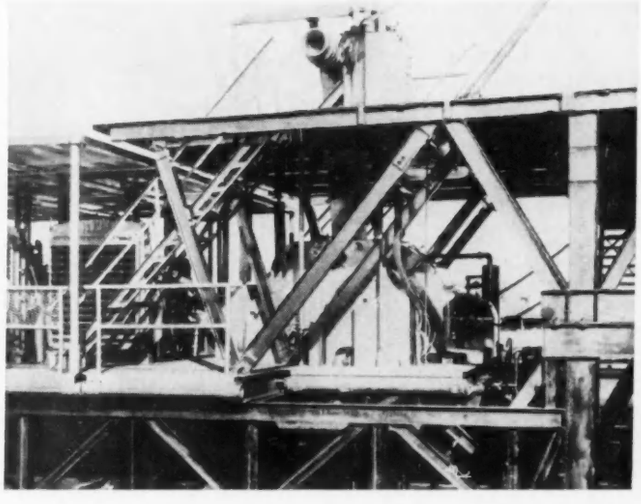
In order that the drilling line from the drum is in a proper position to raise the derrick, a sliding sheave was designed and assembled on the derrick floor directly above the drum and in front of the catshaft (see Figure 2). After the mast is erected, the sheave can be easily removed to reduce the amount of equipment on the derrick floor. Guard rails have been installed



2 The catheads are located on the rig floor directly above the drawworks.



3 Additional bracing reinforces the cathead to eliminate movement.

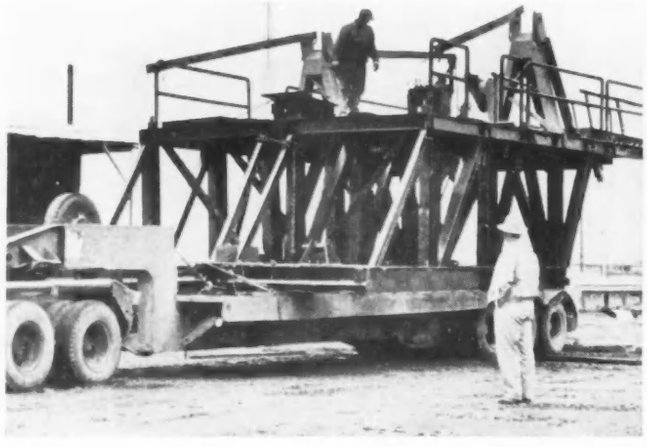


4 Drawworks and engines are located 5 feet off the ground and can be completely enclosed.

5 The lower substructure is transported in two loads by a pole trailer.

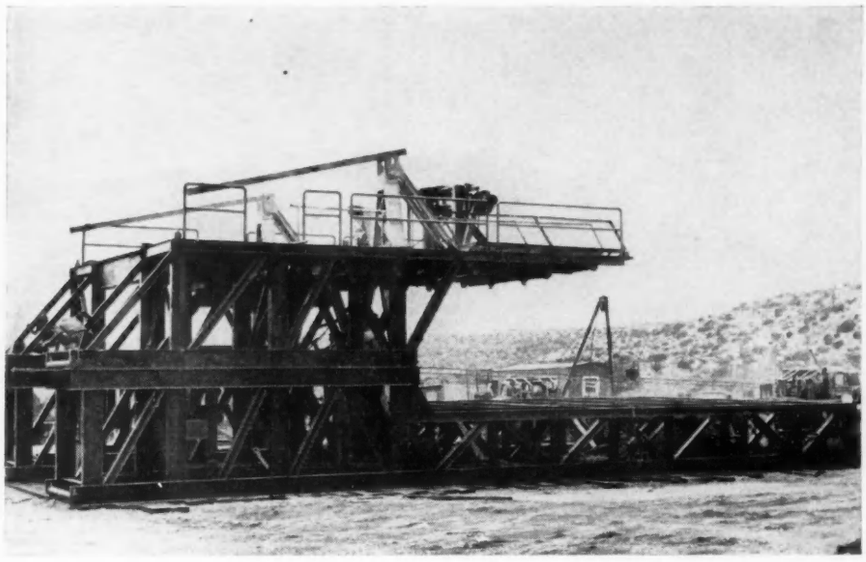
6 Skid-mounted drawworks in two parts and ready to be moved to location.

8 Matting laid, truck loaded with lower substructure is driven onto location.



7 Upper substructure is securely fastened and moved together on a low-boy truck.

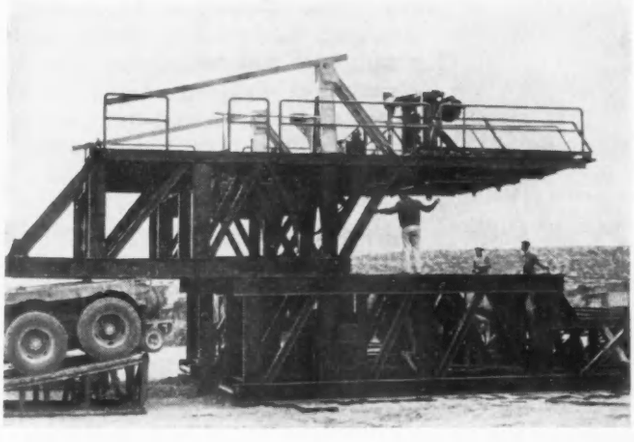
9 A unique operation . . . upper substructure moved by two trucks as a pinned unit.



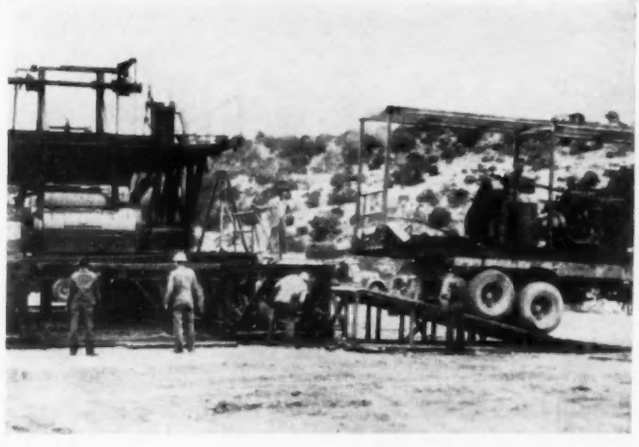
12 Upper substructure is skidded into its final position.

10 Lower substructure positioned . . . upper substructure is being moved up ramp.

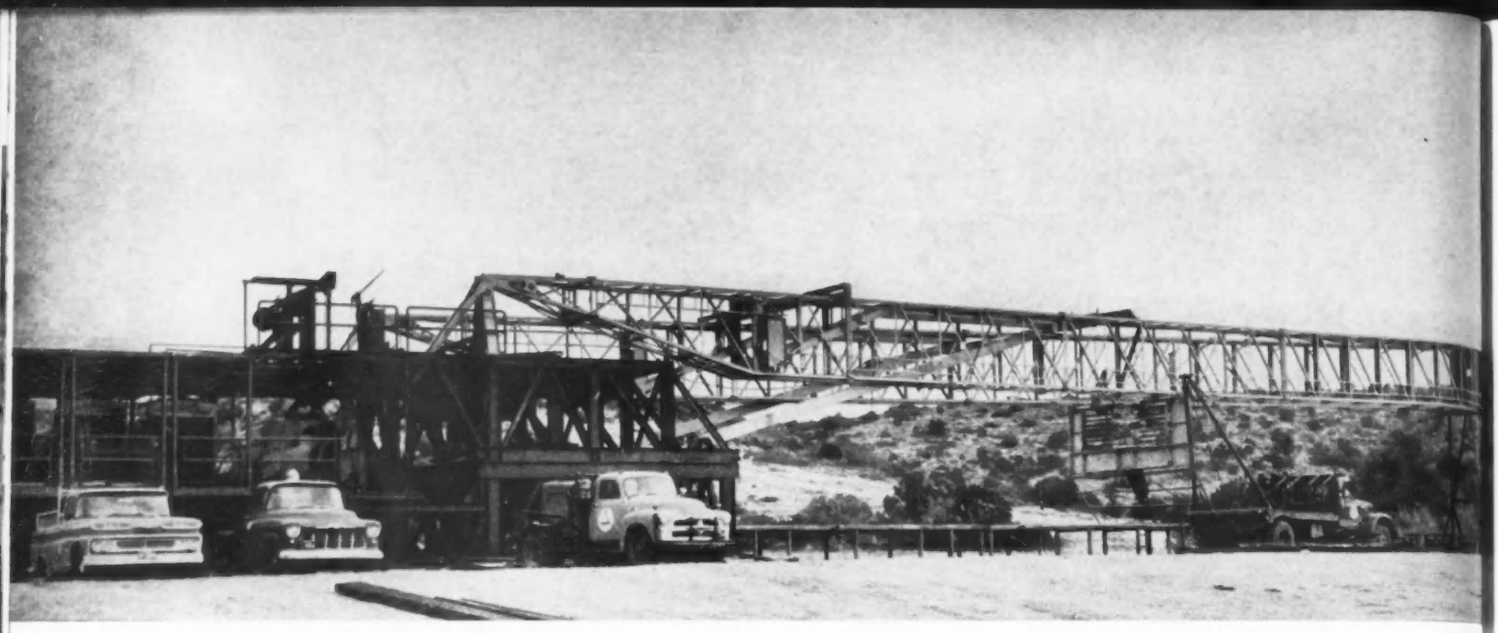
13 The same technique is used to position the drawworks.



11 Upper substructure is almost off truck and being moved into place.



14 The three engines are installed, using same unloading technique.



15 The jackknife mast pinned in position and ready to be raised.

around the drilling line to provide a maximum of safety.

By reducing the engine and substructure height the length of the belt drive to the compressors and mud pumps has been shortened from 480 inches to 360 inches. The shorter belt drive costs less, is easier to guard, and will increase the life and improve operations of the belts.

Transportation of rig. The entire substructure is moved in four loads. Figure 5 shows the lower parts of the substructure being trucked to the location. The lower substructure is 62 feet, 7 inches long and is transported with 2-pole trailers. The upper substructure (composed of two parts) is transported as one unit securely fastened together on a "low-boy" (Figure 6). The pinned center sections of the upper substructure may be removed as one unit, including the rotary table and pipe rack, and moved in one load.

Total weight of the unit, truck, and upper substructure is 90,000 pounds. The drawworks was transported in two loads (Figure 7). The three engines were moved as three separate truck loads. The derrick was transported by two-pole trailers. All loads required special highway size and weight permits; however, no unusual problems were encountered.

Rigging-up. Although rig design was unique and new to the trucking and rig personnel, no unusual rigging up problems were observed. After a few more rigging-up operations are performed and after the personnel becomes more familiar with its assemblage, the rig should be completely erected in a matter of a few hours after the substructure and equipment arrive on location providing rig matting material is positioned properly.

After the matting boards are laid, the pole truck and tractor are driven onto the boards and positioned over the hole (Figure 8). Next, the upper substructure, after being properly pinned together with center sections, is moved as a unit (Figure 9) by two trucks. The trucks are backed up to the two ramps located at the ends of the lower substructure (Figure 10). Next, two trucks are positioned at the other end of the substructure and winch lines are pulled over the substructure and attached to the lower extremities of the upper substructure. After fastening the winch lines to the upper substructure that portion of the substructure is winched into position (Figure 11). The upper substructure is guided onto the lower substructure by guide shoes attached to the lower substructure. After the upper substructure is winched into place (Figure 12), it is securely fastened to the bottom substructure by four pinned beams. These beams prevent movement of either substructure.

After both substructures are in place the drawworks is positioned onto the lower substructure (Figure 13). Although ramps were used for loading the drawworks onto the substructure in this specific instance, the 5-foot substructure is low enough so that in future rigging-up operations ramps will not be necessary. After both halves of the drawworks are in position the three engines are skidded into position in a similar manner as the drawworks (Figure 14).

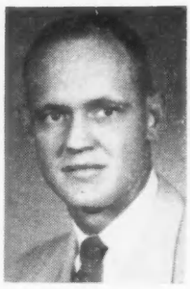
The jackknife mast then is pinned into position (Figure 15) and ready to be raised.

Additional equipment. The rig is equipped with 15 and 18-inch stroke mud pumps and four 600-cfm compressors rated at 125 psi. Three of the compressors are powered from the rig engines and a fourth compressor is individually driven. Mud pumps are driven by the rig engines. Other equipment includes steel pits, soap pump and tanks for mist drilling, and miscellaneous equipment necessary for the operation of a drilling rig. If drilling operations should warrant additional air, separate individually driven compressors may be installed. The air compressors and the 18-inch stroke pump may be powered from the rig drive simultaneously if aerated drilling is necessary.

Performance. A near record drilling time was established while drilling the Cities Service Oil Company Henderson 1. A depth of 10,500 feet was reached 26 days from spud date, drilling with air. No unusual drilling problems were encountered, and all drilling equipment performed satisfactorily.

About the Authors

Durrett



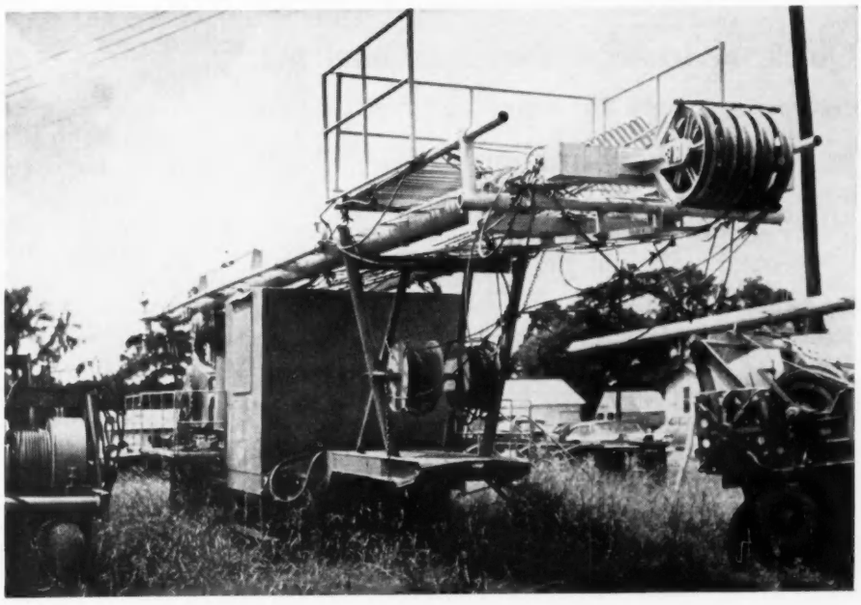
Payne

Edward G. Durrett, Vice President of Delta Drilling Company in the West Texas-New Mexico Division has been associated with Delta for nine years. He formerly served with this company as division manager and drilling superintendent. Durrett majored in petroleum engineering and geology at Texas A. & M. College. He has served as director of the AAODC; past president of the Odessa A. & M. Club and the Permian Basin Chapter of the AAODC, and was the original chairman of the Advisory Board of the School of Drilling Technology. He is at present director of IPAA, Southwest District API, Permian Basin Oil Show, Permian Basin Industrial Foundation, and is a member of the Advisory Committees for the School of Drilling Technology of Odessa College. He was previously employed for 14 years with Loffland Brothers Company.

Bobby R. Payne, engineer trainee-driller for Delta Drilling Company in the West Texas-New Mexico Division majored in petroleum engineering at Texas Technological College. Payne has been in the employ of Delta for two years and is at present serving as driller on Delta Rig 4. Payne, a native West Texan having been raised in Quitaque and graduating from Quitaque High School, worked in the drilling industry for four summers, and while at Texas Tech served as an instructor in the College mud lab. He is a member of the AIME and API. While with Delta he has specialized in various technological studies, and most recently, has been the engineer in charge of the rig conversion outlined in this article.

Use plastic lining in water tank pit to reduce seepage in porous ground

A savings in hauling and unloading water in areas where the ground is porous can be realized by using a plastic lining for the water tank pit. When the mud tanks are dug, the dozer can excavate an additional pit at very little additional expenditure. The pit can then be lined with this plastic material. In several instances, when conditions are right, the lining can be reclaimed for use on the next location.



Spool your guy lines when raising or lowering a telescoping mast

Considerable trouble or delay results when the guy lines become entangled when raising or lowering the telescoping mast. This can be overcome by mounting two wire rope reels above the fifth wheel as shown, and while going through the raising operation the lines will unspool from the respective spools. As the mast is being lowered, the guy lines can be pulled out of the way and then spooled onto the reels for moving.

How to predict diamond bit drilling costs

Quick, accurate method uses total hole cost to compare bit costs and performance in comparable formations

By Robert I. Peters,
Research & Development Engineer, Christensen Diamond Products Co., Salt Lake City, Utah

A NEW METHOD of diamond bit evaluation provides a quick and accurate means for comparing diamond bit drilling costs with costs resulting from other drilling methods.

Inherent differences existing between diamond bit and rock bit performance, in comparable formations, make direct comparisons between these two types of bits extremely inaccurate unless total hole costs are considered. To help define and predict diamond drilling costs, in terms that can be compared with drilling costs by other methods, a mathematical technique has been developed which permits comparing diamond bit costs with rock bit costs. The method, involving simple formulas and curves, is based on total hole costs consisting of:

- Actual rig costs in dollars per hour
- Net cost of bit
- Round trip time expressed in hours

After a diamond bit has been run, it is a simple matter to compare the cost of the bit with an established rock bit cost in the same section. However, it is extremely desirable to be able to *predict* diamond bit costs for any given formation and hole condition.

A relatively simple method was developed whereby the required diamond bit performance may be determined in advance to produce the same over-all cost that would result from using rock bits. Effects of penetration rate, trip time and net bit cost are included in the computations, making the comparison more valid, since all these factors must be considered in a final cost analysis.

Determine costs. The first computation would be to determine the present rock bit drilling cost based on existing fixed costs. For example, assume the following conditions:

Rig Cost: $50 per hour
Rock Bit Cost: $250 per bit
Rock Bit Life: 10 hours per bit
Feet Drilled: 50 feet per bit
Trip Time: 5 hours

The rock bit drilling cost may be determined by the following formula:

$$\text{Rock Bit Drilling Cost (\$/Ft)} = \frac{(\text{Drlg. time} + \text{trip time}) \times \text{Rig Cost} + \text{Rock Bit Cost}}{\text{Feet Drilled}} \quad (1)$$

By making proper substitutions from the above rig conditions total rock bit drilling cost is derived as follows:

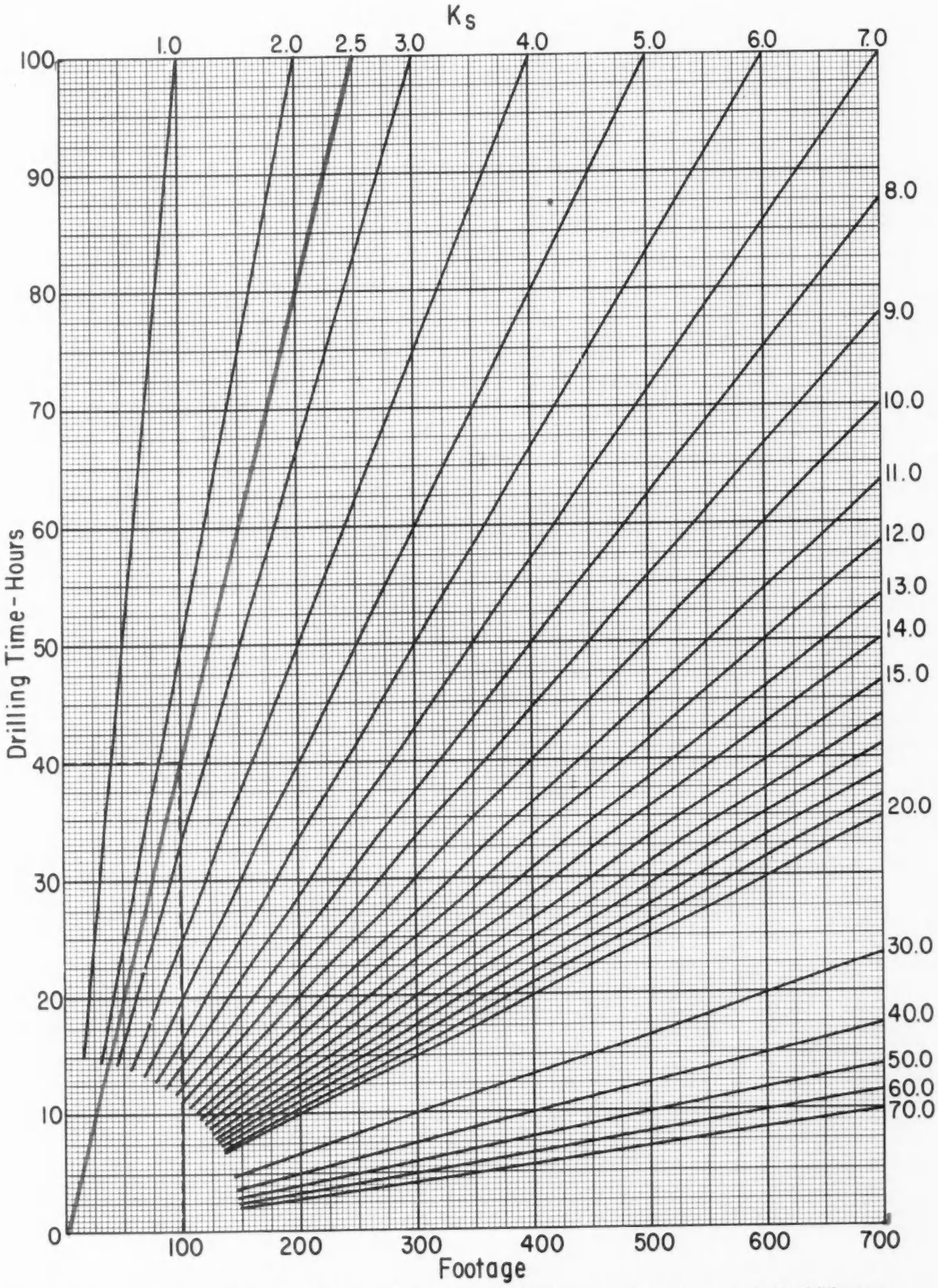


CHART 1—Footage and drilling time for various values of K_s, the ratio of rig cost to rock bit drilling cost.

$$\text{Rock Bit Drilling Cost (\$/Ft)} = \frac{(10+5)\times 50+250}{50}$$
$$= \$20/\text{Foot}$$

Next, determine the ratio of the rig cost to the rock bit drilling cost, which will be called K_s.

$$K_s = \frac{\text{Rig Cost}}{\text{Rock Bit Drilling Cost}} \qquad (2)$$

The rig cost in this example is $50 per hour, while the rock bit drilling cost was calculated at $20 per foot. Therefore, substituting,

$$K_s = \frac{50}{20} = 2.5$$

The third computation is to determine the ratio of trip and diamond bit cost to the rock bit drilling cost. This ratio is identified as K_f. Then,

$$K_f = \frac{\text{Trip Time} \times \text{Rig Cost} + \text{Diamond Bit Cost (net)}}{\text{Rock Bit Drilling Cost}} \qquad (3)$$

The trip time in this example is 5 hours; rig cost is $50 per hour, and the rock bit drilling cost has been determined to be $20 per foot. This leaves the diamond bit cost as the only unknown quantity. At this point it becomes necessary to estimate a net diamond bit cost (sale price minus diamond salvage). For this example, assume a net cost of $1,250 for the diamond bit. Then, by applying the above formula (3), and solving for K_f,

$$K_f = \frac{5\times 50+1250}{20} = 75$$

Footage, penetration rates from chart. The final step is to establish total footage and penetration rate (feet/hour) at which a diamond bit must perform in order to result in the same drilling cost as produced by drilling with rock bits. This is accomplished by referring to chart No. 1 which shows footage vs. drilling time for various values of K_s. In the above example, K_s was found to be 2.5 which appears as a red line on chart 1. From this the tabulation as shown in the following chart No. 2 can be made.

CHART 2

Drilling Time-Hrs. (From chart 1)	Footage (From chart 1)	K_f	Total Footage (Footage+K_f)	Penetration Rate (Tot. Ft/Drilling Time)
20	50	75	125	6.250
40	100	75	175	4.375
50	125	75	200	4.000
60	150	75	225	3.750
70	175	75	250	3.571
80	200	75	275	3.437
90	225	75	300	3.333
100	250	75	325	3.250

Select a convenient series of drilling times as shown in the lefthand column of chart 2. Now, referring to chart No. 1, locate the intersection of the horizontal lines representing these drilling times with the line "$K_s = 2.5$." Drop down on a vertical line from these points of intersection and find the corresponding footage. Enter this figure in the column headed "Footage" in chart 2. For example, to select a drilling time of 40 hours, draw a horizontal line through this point on chart 1 until it intersects the line "$K_s = 2.5$." From this intersection, drop down to the footage line to find the value of 100. This figure, 100, is entered in chart 2 opposite its corresponding drilling time of 40 hours.

The "Total Footage" shown on chart 2 then is obtained by adding the factor K_f to the footages taken from chart 1.

For instance, for a drilling time of 40 hours the corresponding footage taken from chart 1 is 100, and the total footage is

$$100 + K_f$$
$$\text{or, since } K_f = 75 \text{ (Formula 3)}$$
$$\text{Total Footage} = 100 + 75, \text{ or } 175 \text{ feet}$$

This represents the total footage a diamond bit must drill in 40 hours to match the rock bit cost of $20/foot. The penetration rate, shown in the right hand column of chart 2, is computed by dividing the "total footage" by the corresponding drilling time shown in the left-hand column.

Cost comparisons from curve. A graphical representation of this solution is shown in chart 3 where the penetration rate is plotted against the total footage. Diamond bit performance which falls on the curve will result in the same drilling cost as the rock bit. Diamond bit performance above the curve would represent reduced drilling cost, and diamond bit performance below the curve would represent increased cost over rock bit drilling.

For example, assume that a diamond bit has drilled a total of 100 feet at a rate of 5 feet/hour. This condition is indicated on chart 3 by the small circle to the left or below the curve, and would result in an increased drilling cost, as computed below:

100 feet @ 5 feet/hour = 20 hours drilling time
Rig Time = $50/hour
Bit Cost (net) = $1,250
Trip Time = 5 hours

$$\text{Drilling Cost (\$/ft)} = \frac{(\text{Drilling Time} + \text{Trip Time}) \times \text{Rig Cost} + \text{Net Bit Cost}}{\text{Feet Drilled}}$$

or, substituting,

$$\frac{(20+5)\times 50+1250}{100} = \$25/\text{foot}$$

as compared to rock bit drilling costs of $20/foot.

Correspondingly, bit performance that falls above or

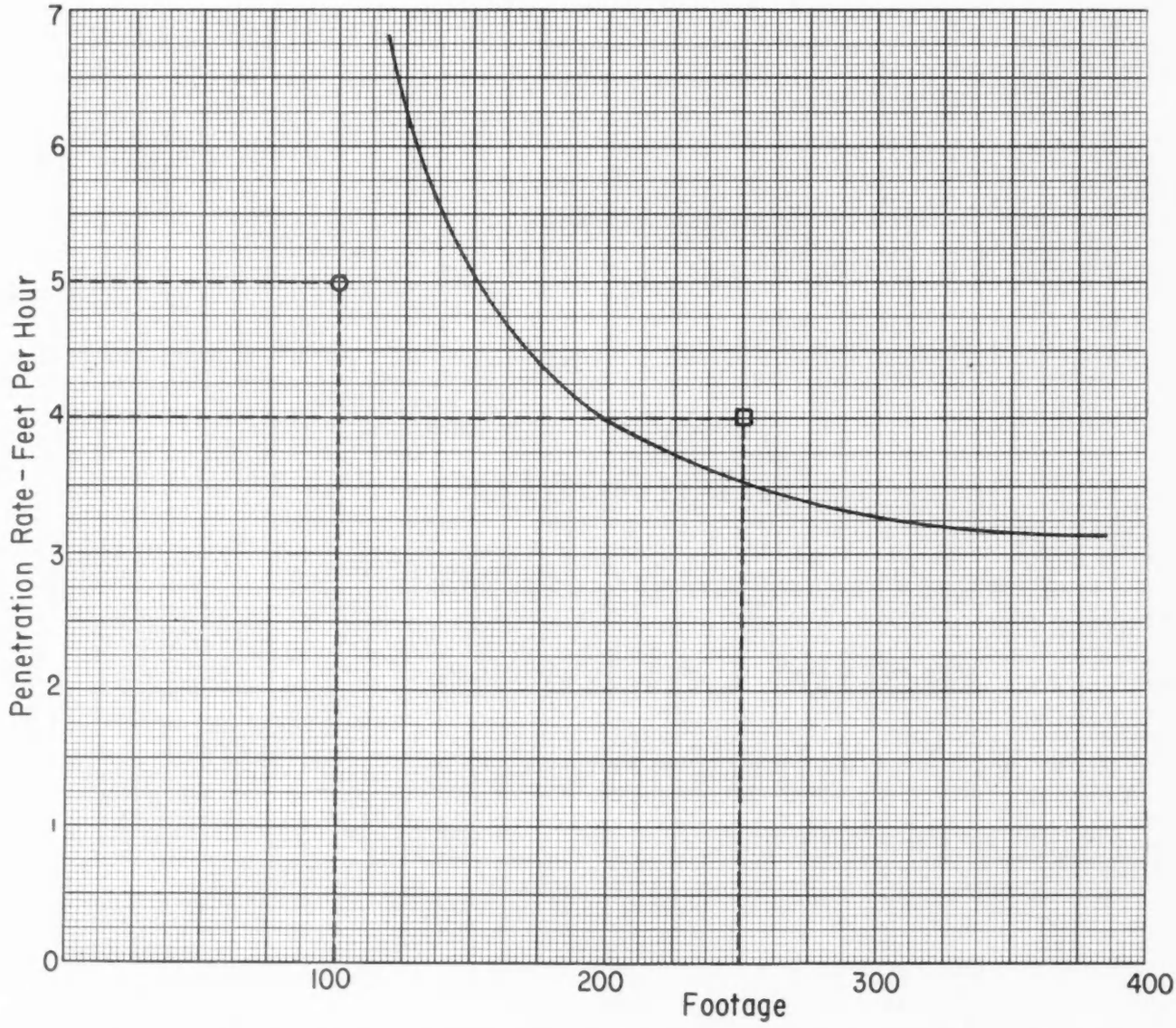


CHART 3—Graphical means of arriving at bit performance by plotting penetration rate against total footage.

to the right of the curve would result in reduced drilling cost.

If, for example, a bit were to drill 250 feet at a rate of 4 feet/hour (as represented by the small square on chart 3), then the drilling time would be

$$\frac{250 \text{ ft.}}{4 \text{ ft/hr.}} = 62.5 \text{ hours}$$

and drilling cost would be

$$\frac{(62.5 + 5) \times 50 + 1250}{250} = \$18.50/\text{foot}$$

as compared with $20/foot for rock bits.

It may be noted from the above analysis that the only variable is the cost of the diamond bit which, in this example, was estimated at $1,250. Reasonable estimates of this factor should be available from sources familiar with diamond bit performance and operation.—**The End**

About the Author

Robert I. Peters, born in Orange, Cal., was graduated from Pasadena (California) Junior College in 1945. He was in the Navy from 1945 to 1946 and, following release, attended Colorado School of Mines at Golden, Col. He was graduated in 1951 with degree of petroleum production engineer. Following two years of experience as roustabout, mud engineer and production engineer in California, he joined Creole Petroleum Corporation as a drilling engineer in Venezuela and was with that company until 1957. He now is employed by Christensen Diamond Products Company, Salt Lake City, Utah, as a research and development engineer.

Engineered hydraulic programs reduce California drilling costs

Penetration rates increase and drilling costs decrease as engineered hydraulic programs are applied to each job

By B. M. (Bill) Bumgardner, Field Engineer, Hughes Tool Company, Bakersfield, Cal.

Improved drilling practices and techniques have cut drilling costs in California.

Found to have been effective aids in cutting costs were:

- More efficient hydraulics and a better understanding of their use.
- The use of lower annular velocities.
- The limiting of maximum pump pressure to 2,500 psi, in most cases.
- Increased weight on the bit so as to increase penetration rates, although crooked hole conditions dictate caution in utilization of this practice.
- A more efficient use of rig horsepower resulting from the minimum circulation rates believed necessary for adequate annular velocity.
- The maintaining of an accumulative drilling cost curve so a clear and accurate cost-per-foot figure is made available.

Annular velocity. For several years, the standard figure for minimum annular velocity has been about 180 feet per minute, regardless of hole size. With the equipment in use and the large holes being drilled in California, 180 feet per minute is almost impossible to obtain and still have good jet bit hydraulics.

A different approach has been taken and tests have been conducted to determine the minimum annular velocity that would keep the hole clean. The absolute minimum annular velocity has not as yet been established although many feet of hole have been drilled in almost every area in California. Table 1 is a list of some of the holes that have been drilled in California using low annular velocities.

Problems. There were no unusual problems noted on any of these wells. In several cases, the crews had less trouble making round trips in the lower annular velocity holes than they had experienced when drilling with higher annular velocities.

On a program in Hall Canyon, near Ventura, water was used as the drill-

TABLE 1

Low Annular Velocity Test Holes

Field	Hole Size In Inches	Av. Drilling Rate Ft. Per Hour	Annular Velocity Ft. Per Min.	Interval Drilled Feet
Antelope Hills	9⅞	125	110	150- 2,200
Paloma	10⅝	30	70	4,000- 9,000
Old River	9⅞	30	135	7,000-11,000
Arvin	9⅞	25	45- 90	6,500- 9,000
*Wheeler Ridge	10⅝	40	110	2,000- 5,300
Tejon	10⅝	10	110	6,700- 8,700
Paloma	7⅝	85	125	500- 5,600
Castaic	9⅞	30	145	7,000-11,000
Brea	9⅞	20	90-100	4,000- 7,600
**Riverdale	7⅞	300-100	125	500- 7,000
Coalinga	9⅞	50	125	500- 9,300
Hall Canyon	10⅝	200- 50	130	1,200-10,000

* 8 holes
** 5 holes

ing fluid. There was no hole trouble noted even though the annular velocity was only 90 feet per minute in the 12¼-inch portion of the hole and 130 feet per minute in the 10⅝-inch hole.

Annular velocity is a function of the hole size, drill pipe size and the circulation rate (gallons per minute). Average penetration rate in most of the 9⅞-inch holes in California is 50 feet per hour, or less. A circulation rate of 380 GPM, with 4½-inch pipe in a 9⅞-inch hole, will result in an annular velocity of 120 feet per minute.

When drilling at a rate of 50 feet per hour, the formation being removed would amount to about 3.4 GPM. The consensus is that the 380 GPM of drilling fluid will remove the 3.4 GPM of formation. In the Hall Canyon test, as much as 20 GPM of formation was going into 460 GPM of water, which was being used as the drilling fluid, yet the cuttings were removed and the hole was cleaned adequately.

Table 2, is a list of the popular hole sizes and the amount of formation being removed when drilling at a rate of 100 feet per hour.

Minimum annular velocities proposed for use in California to calculate hydraulic programs are listed in Table 3.

Many times, when the annular velocity has dropped much below these minimums, no hole trouble was noticed.

Low annular velocities were used in holes where several whipstocks were set and no hole trouble resulted. However, low annular velocities have not been tested in directional holes where the angle was greater than 10 degrees. Due to the lack of test holes, it is not known whether the lower annular velocities will keep the hole clean when drilling gravel beds or the very sticky shales. The most important criterion when selecting a low annular velocity is common sense and reliable experience.

Pressure. Within practical limits, the most economical jet programs are those that stress minimum circulating volumes and maximum pressures. A circulation rate that will yield the required minimum annular velocity will allow the maximum available pressure to be used at the bit instead of being consumed as line friction.

For most conditions in California, a maximum surface pressure of 2,500 psi, when properly used, will yield good hydraulics. With heavy mud weights (120-130 pounds per cubic foot) and deep, small holes (12,000 feet, 3½-inch drill pipe), the pressure may exceed 2,500 psi, but these are extreme cases in California.

Satisfactory improvements in jet programs have been made to around 9,000 feet with a maximum surface pressure of 1,600 psi in 9⅞-inch and 10⅝-inch holes with 75 pounds per cubic feet mud. Substantial improvements occurred when maximum surface pressure of 1,400 psi was used to drill five 7⅞-inch holes to 7,000 feet with 3½-inch drill tubing. Shallow (2,000-3,000 feet) holes being drilled with 1,000 psi have shown improvement over former methods which accented high circulating volumes.

Prior to the initiation of planned hydraulic programs, most rig pumps were operated with large liners and were overloaded from 25 to 100 percent. The gage pressure on a majority of the programs was not increased more than 200 psi, and no pump was overloaded more than 5 percent. The near constant pressures did not appreciably increase fluid end wear, and the power end maintenance was reduced because of operating at rated loads.

Jet velocity. Jet velocities in the discussed wells ranged from 250 feet per second to 470 feet per second. Velocities in the higher range were preferred, but satisfactory results were obtained with jet velocities of 250 feet per second. Minimum jet velocities required to show improvements in penetration rates are believed to be greater in hard formations than in soft formations.

In extremely soft formations, a jet velocity of 250 feet per second might be very effective, but a jet velocity of 350 feet per second might be of marginal benefit in the very hard formations. Jet programs normally should be calculated within the range of 250-500 feet per second. When the jet velocity drops below 250 feet per second in 7⅞-inch and larger holes, a marginal condition probably exists and the economics of jet bits should be determined by alternating regular

TABLE 2

Formation Removed from Various Hole Sizes

(Based on a penetration rate of 100 feet per hour)

Hole Size Inches	Gallons Per Minute of Formation
7⅞	4.2
8¾	5.2
9⅞	6.7
10⅝	7.7
12¼	10.2

TABLE 3

Minimum Recommended Annular Velocities

(Based on findings to date)

Hole Size Inches	Annular Velocity Feet Per Minute
12¼	80
10⅝	90
9⅞	100
8¾	100
7⅞	120
6¾ and less	130 or greater

About the Author

B. M. (Bill) Bumgardner received a B.S. degree in mechanical engineering from Louisiana State University in 1958. He joined Hughes Tool Company upon graduation and was assigned duties in South Louisiana and in Houston. In December 1959 he transferred to California and assumed the duties of field engineer. His present position is field engineer in the Bakersfield, Cal., office of the company.

bits with jet bits and calculating the cost per foot of hole drilled by each.

Jet nozzles. To obtain the most efficient hydraulic program, jet nozzles should be changed as hole depth increases or as the mud weight increases. Jet nozzles of different orifice sizes should be used.

As an example, instead of stepping from three 3/8-inch jets to three 13/32-inch jets, it would be more efficient to proceed in the following manner: three 3/8-inch, then two 3/8-inch and one 13/32-inch, then two 13/32-inch and one 3/8-inch, and then three 13/32-inch. The gradual increase in jet sizes will allow the maximum amount of horsepower to be used at the bit with little variance in pump speed.

If plugging of small jets becomes a problem, two larger jet nozzles (with the same area of the three smaller jet nozzles) and a blank nozzle can be substituted. More than 150 bits have been run using a blanked off jet, and no bearing failures have been caused by the practice.

Proper utilization of pumps and their power source. A large amount of available horsepower to the pump or high gage pressure does not necessarily mean good hydraulics at the bit.

A comparison was made with a small rig going to 5,000 feet and a much larger rig drilling a deep test around 600 yards away. Both rigs were drilling 10 5/8-inch holes. At 5,000 feet, the smaller rig was supplying 430 horsepower to the pump, had 250 hydraulic horsepower at the bit and a nozzle velocity of 345 feet per second. At 5,000 feet, the larger rig was supplying 670 horsepower to the pump, had 280 hydraulic horsepower at the bit, and had a nozzle velocity of 315 feet per second. By proper utilization of the 670 input hrosepower, the larger rig could have had 445 hydraulic horsepower at the bit and 460 feet per second nozzle velocity.

The following conditions are assumed to demonstrate the efficient and inefficient methods of using rig hydraulic equipment:

Hole Size—9 7/8-inch
Pump—16-inch
Strokes per minute—60
Maximum pressure—1,560 psi with 6-inch pump liner
1,130 psi with 7-inch pump liner
Drill collars—300 feet 2 3/4-inch I.D. x 7-inch O.D.
Pipe and tool joints—4 1/2-inch full hole
Mud weight—75 pound per cubic foot
Horsepower—420

Under these conditions, a jet velocity of 250 feet per second could be maintained to a depth of 12,300 feet with 6-inch pump liners. At a depth of 7,000 feet when using the 6-inch liners, 61 percent of the hydraulic horsepower would be at the bit, and the nozzle velocity would be 321 feet per second. A jet velocity of 250 feet per second could be maintained to only 3,000 feet with a 7-inch pump liner.

An attempt to go deeper with a 7-inch liner would result in the use of regular bits or the inefficient application of jet bits to around 7,000 feet. At 7,000 feet the pump would be overloaded without a bit on the drill string.

Weight on the bit. It is common knowledge that an increase in weight on the bit generally will increase the penetration rate, if hydraulics are adequate to keep the bit clean. Heavy weight tests have been conducted in California, but due to crooked hole problems, these tests to date generally have been unsuccessful. Increased weight on the bit was attempted on only one of the wells mentioned in this paper. The results were outstanding, even though the maximum weight did not exceed about 30,000 pounds on a 9 7/8-inch bit.

How to figure what a foot of hole costs. Equation 1 is an established method for calculating the cost per foot of hole drilled.[4]

$$C = \frac{B + D \cdot R + T \cdot R}{F} \qquad (1)$$

Where:

C = Drilling cost, dollars per foot
B = Bit cost, dollars
D = Drilling time, hours
R = Rig operating cost, dollars per hour
T = Round trip time, hours
F = Footage drilled by bit, feet

To demonstrate—assume the following data:

Rig operating cost	$ 50.00 per hour
Bit cost	$200.00
Round trip time	0.6 hour per 1,000 feet

Bit No.	Depth Out	Footage	Hours	Feet Per Hour
1	12,000	50	10	5.0
2	12,065	65	14.5	4.5

Bit (1)
$$C = \frac{\$200 + (10 \text{ hour})\ (\$50/\text{hour}) + (7.2 \text{ hour})\ (\$50/\text{hour})}{50 \text{ feet}}$$
$$= \$21.20 \text{ per foot}$$

Bit (2)
$$C = \frac{\$200 + (14.5 \text{ hour})\ (\$50/\text{hour}) + (7.22 \text{ hour})\ (\$50/\text{hour})}{65 \text{ feet}}$$
$$= \$19.80 \text{ per foot}$$

In using this formula, the drilling time factor should include only the actual time that the bit is on bottom drilling, but for simplicity, connection time can be included with very little

error. Circulation time for samples, down time for repair, etc., should not be included in drilling time. Round trip time should be the average time consumed from the time one bit leaves the bottom until the next bit starts drilling. Round trip time should include down time for normal rig servicing, surveying and normal reaming time. Rig operating cost should be the value that the owner placed on the rig when he is bidding a hole. It should include the normal profit margin, direct operating costs and maintenance costs.

Accumulative drilling cost curve. The accumulative drilling cost curve is a practical method of separating the direct drilling cost from the many other variables encountered when drilling a well. It is a good control device on all wells, but is extremely important on any planned program.

The drilling cost formula (Equation 1) is used to calculate the accumulative drilling cost. Since the drilling cost formula accounts for a majority of the time consumed in drilling a well, the accumulative cost curve should run approximately parallel, but lower than the 24-hour depth progress curve that is normally kept. (This is valid when the value placed on the rig in dollars per day is made equal in scale to one 24-hour day.)

When the accumulative cost curve is running a great deal lower than the 24-hour curve, it points out that the rig time is being spent for purposes other than drilling and making normal round trips. This time could be used for casing and cementing, fishing, circulating for formation samples, testing, coring, major repairs or slower round trips than planned. Accurate data are essential for reliable evaluation computations. A multi-channel recorder is very helpful in collecting the necessary data, because the performance data collected by the recorder can be used to compute the total cost for each drilling bit run under the surface pipe.

The surface hole normally should be neglected due to unpredictable surface formations in California. Whipstock bits should not be included in the calculations. To demonstrate the accumulative drilling cost calculations, Table 4 was prepared to show costs on an assumed location.

The above data are plotted along with an imaginary curve of a comparison well in Figure 1. The savings would be $2,330.

Steps in planning an efficient hydraulic program. Following are steps in one of several methods of planning an efficient hydraulic program.

- Select the minimum practical annular velocity. (See Table 3)
- Select a liner that will give the desired annular velocity when the pump is operating near rated speed.
- Design the program to utilize maximum pressure of the pump liner. If there are pressure limitations other than the manufacturer's ratings of the liner, use this maximum pressure limitation. To avoid high pump maintenance costs, do not exceed 2,500 psi under normal conditions.
- Plan the jet program so that maximum pressure will be maintained by:
  1 Changing jet sizes as the hole deepens,
  2 Slightly varying the pump's speed.
- Design a practical program. Do not go to extremes on either low annular velocity or high jet velocity. Plan to maintain jet velocities within the range of 250-500 feet per second.
- Have a multi-channel recorder on the rig. The recorder should not be used as a tattle-tale, but as an instrument that will produce reliable data.

The recorder should include penetration rates, weight on bit and pump

TABLE 4

Accumulative Drilling Cost

Assume: Round Trip Time .6 hours per 1,000 feet
Bit Cost $200.00
Rig Cost $ 50.00 per hour

Bit No.	Depth Out	Footage	Hours	Bit Cost $	Drilling Cost $	Trip Cost $	Total Cost $	Accumulative Cost $
1	2,000	1,000	10	200	400	60	760	760
2	3,000	1,000	15	200	750	90	1,040	1,800
3	3,500	500	10	200	500	105	800	2,600
4	4,000	500	15	200	750	120	1,070	3,670

TABLE 5

Comparison Showing Improvements Gained By Planned Hydraulics

	Calculated Hydraulics	Pre-Hydraulics
Total Footage	8,796	8,788
No. of Bits Used	17 New	32 (23 Retip, 9 New)
Average Footage per bit	518	274
Total Rotating—hours	231	290
Average Drilling Rate—Feet per hour	38.1	30.4
Total Cost	$17,831	$24,077
Average Cost per foot	$2.03	$2.74

TABLE 6

Summary of Results In Planned Hydraulic Holes

	Calculated Hydraulics	Pre-Hydraulics
Number of Wells	11	10
Total Footage	49,890	49,682
No. of Bits Used	213	284
Average Footage per bit	234	175
Total Rotating Hours	2,104	2,578
Average Drilling Rate—ft per hr	23.7	19.3
Total Cost	$196,200	$230,000
Average Cost per foot	$3.93	$4.63

pressure. In many cases, rig down time has been recorded as drilling time; therefore, by the use of this instrument, a company can put repair time, drilling time, etc. in their proper perspectives.

- Maintain an up-to-date accumulative drilling cost curve.
- Rig personnel must be informed of the impending program. They should know what is to be gained by the program, what effect the program will have on the rig equipment, and what effect the program will have on their jobs.

Hydraulic programs can be sold to crew members by explaining to them how efficient hydraulics reduce the number of bits and round trips. Drillers can be sold by talking about the economics of the program, the reduced number of trips that will be made, or the possible decrease in pump repairs. Toolpushers are enthusiastic if they are shown how they can reduce the number of bits or reduce the total number of days to drill the hole.

Results of these programs. A contractor drilled two 9⅞-inch holes near Coalinga with the same rig and toolpusher. On the pre-hydraulics hole, 7-inch liners were used in a 16-inch pump and the pump was operated fast enough to maintain an annular velocity approaching 180 feet per minute. A combination of regular retip bits and jet retip bits (nozzle velocity below 200 feet per second) were used on top hole. New regular bits were used in the bottom 1,000 feet of the hole. The maximum gage pressure was 1,000 psi. The weight on the bit was approximately 10,000 pounds.

The planned hydraulic program was calculated on a basis of an annular velocity of 125 feet per minute. The maximum surface pressure with 6-inch liners in the 16-inch pump was 1,600 psi. All new jet bits were used with jet nozzle velocities varying from 356 feet per second on top hole to 300 feet per second at 9,000 feet. The weight on the bit ranged from 25,000 to 30,000 pounds. Pump repairs were normal and hole conditions were good.

See Table 5 and Figure 2 for the results of this test.

This comparison shows 89 percent increase in footage per bit, 25.4 percent increase in drilling rate, and 25.9 percent reduction in drilling cost.

Table 6 is a summary of the planned

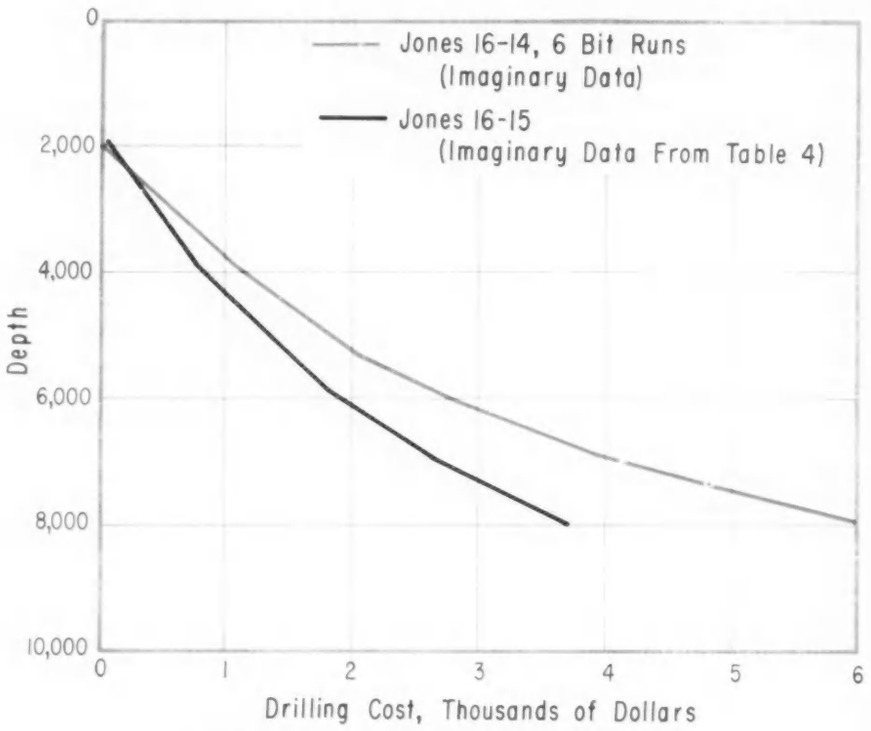


FIGURE 1—Accumulative drilling cost curve.

Comments presented by W. E. Schultz, Division Engineer Loffland Brothers Company, Los Angeles

In the past few years we have seen a change from thinking of high annular velocities as beneficial, to that of considering high annular velocities as being detrimental toward maintaining a hole free of trouble. Along with this change in thinking has been a continual change in mud practices toward lower solids, lower viscosity and thixotropic properties, which have improved removal of cuttings but which also have increased erosion action.

Table 1 gives a list of low annular velocities tested. The actual annular velocity is, of course, reduced by the amount of hole enlargement, which in extreme cases must be taken into consideration. Another point to consider in an evaluation of minimum annular velocity is pump volumetric efficiency. In a few cases, where the mud had a high plastic viscosity and yield point, we have experienced a reduction in volumetric efficiency to 75 percent instead of the normal figure of 90 percent.

Using the minimum annular velocities recommended in Table 3 of the paper—for example the 90 feet per minute in 10⅝-inch hole—and applying the 75 percent volumetric efficiency, an annular velocity of 75 feet per minute would be obtained. A further reduction of one-third for hole enlargement would make the actual annular velocity 50 feet per minute. This may or may not be sufficient for maintaining a clean hole. The point is that pump efficiency as well as hole enlargement should not be overlooked in the evaluation of annular velocities. This example additionally points out the desirability of good mud flow properties as an adjunct to good hydraulics.

Previous work has indicated a maximum cuttings slip velocity in the range of 0.5 foot

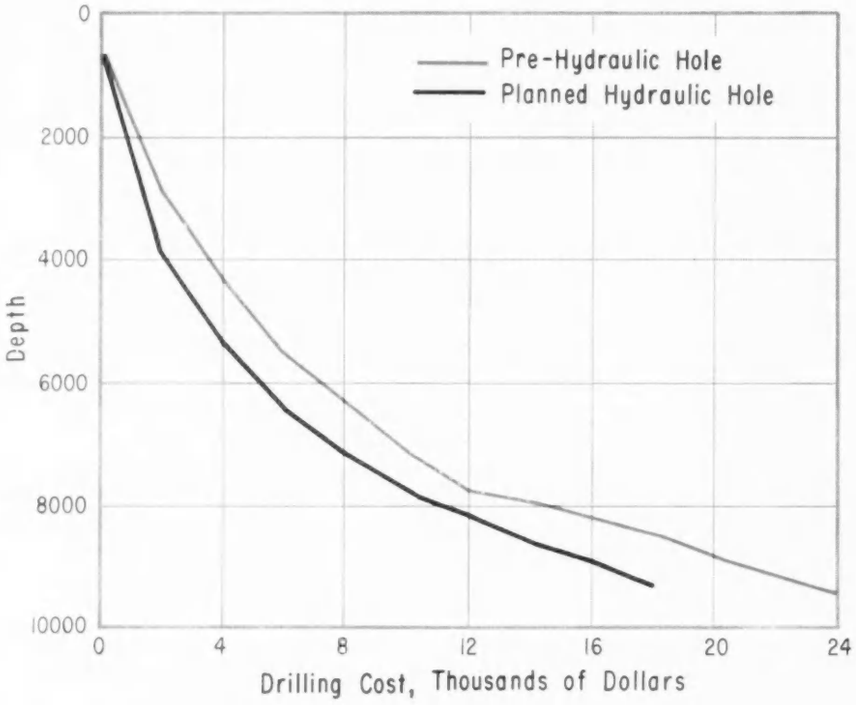


FIGURE 2—Accumulative drilling cost.

hydraulic holes drilled in California, where accurate cost comparisons could be made.

This over-all comparison shows 33.7 percent increase in footage per bit, 22.8 percent increase in drilling rate, and 15.1 percent reduction in drilling cost on the hydraulic program wells.

This article is based on a paper titled "Reduction of Drilling Cost in California by the Use of Engineered Hydraulic Programs" presented at the API Spring Meeting of the Pacific Coast District Division of Production, Los Angeles, Calif., 1961.

Acknowledgment

The author wishes to express appreciation to the management of the Hughes Tool Company for their permission to assemble and present this paper, and to the field personnel who helped conduct these tests. Special acknowledgment is made to the drilling contractors who made these tests possible.

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per second for normal size drill cuttings when using mud with average properties. With this in mind, an actual annular velocity of one foot per second, or 60 feet per minute, was suggested by Mr. P. W. Cooke of British Petroleum in 1957 as adequate for the removal of cuttings under either turbulent or laminar mud flow conditions. It would appear from the recent tests in California that the proposed use of a low annular velocity is now being employed successfully. Instead of recommending different annular velocities for various size holes as given in Table 3, a single rule-of-thumb figure such as 60 feet per minute annular velocity based on estimated hole size due to enlargement, or 90 feet per minute annular velocity based on bit size would be more acceptable as an established minimum, regardless of hole size.

In our operations in California for the past year, we have employed annular velocities, based on guage 9⅞-inch and 10⅝-inch holes, in the range of 120 to 130 feet per minute. Lower annular velocities apparently would have been adequate for cleaning the holes. However, the annular velocities obtained in these operations were the result of using the maximum from a 1000 horsepower pump, using a pressure limitation of 2600 psi and a minimum jet nozzle area equivalent to three 11/32-inch jets; and with these restrictions, the annular velocity attained could not be lowered without reducing the horsepower delivered to the bit. The minimum jet nozzle limitation was used to avoid bit plugging and excessive trip time, and the pressure limitation was used to control pump maintenance costs. With this program we have used jet velocities of approximately 500 feet per second and bit hydraulic horsepowers of approximately 500 to 550 with good results.

The exceptions we have taken to low annular velocity thus far have been in sloughing formations, such as the weathered basalt in the Tejon field area and in high angle holes having angles upwards of 50 to 60 degrees. In these cases annular velocities based on gauge hole of 165 feet per minute normally have been used.

In addition to the advantage of reduced footage cost are the advantages associated with faster drilling, which are generally not adequately considered. These advantages may be summarized as follows:

1. Less hole hazard from hole erosion, keyseating, and caving shales.
2. Reduced filtrate and mud particle invasion in productive zones, which should reduce well completion costs.
3. Reduced mud costs.
4. Faster return on investment by placing the well on production sooner, and less tie-up of capital appropriated for the work.

DRILLING PROGRESS

New wellhead assembly saves rig time

The blowout preventers are installed on the conductor pipe and are not removed until final installation of the tubing hanger and conventional tree

By Virgil D. Stone
Area Drilling Foreman
Gulf Oil Corp.
Morgan City, La.

A NEW WELLHEAD assembly designed to reduce rig time has been introduced to the oil industry by Gulf Oil Corporation for use in various fields along the Louisiana Coast.

The assembly offers the following:

- Elimination of two to three days rig time from common wells. This is accomplished by reducing "nipple-up" time following the setting of each string of casing. Blowout preventers are installed only one time with no subsequent spool installation or preventer removal until the tree is installed just prior to bringing in the well.
- Minimizing nippling-up installations safety hazards, which are greatest on offshore jobs because of the inherent working conditions, followed by inshore marine and land operations.
- Elimination of a 20 or 18-inch bag-type blowout preventer while drilling the surface hole.
- Increased strength of blowout preventer connection, thus, eliminating any problem of breaking off conventional screw-on casing heads due to cracks at the last engaged casing thread.

The new assembly has several applications, some of which have been proven through field use while others are proposed. The following conditions enhance the use of this type of assembly:

- Drive pipe (16 to 36 inches OD) is either necessary or economical to use as first string of casing.
- A blowout preventer is needed while drilling the surface hole (to 6,000 feet).
- No conductor pipe other than the drive pipe is needed (except as a substitute to drive pipe).
- Surface casing is 10¾-inch OD or smaller.
- The third casing string is 7⅝-inch OD or smaller.
- Blowout preventers available are at least 12-inch series 900 or 12-inch series 1500 (14-inch flanges), depending upon anticipated pressures. Other profitable applications can be made on wells which do not use drive pipe and conceivably on wells which require 13⅜- or 9⅝-inch casing.

FIELD APLICATION

Stage 1. The conductor pipe is in place, preferably driven with a hammer before the rig arrives at location, and a 4-inch nipple is welded to the pipe with a 4-inch valve installed. The head is welded to the conductor pipe around its circumference. All work to this point may be done prior to the rigs arrival.

Next, the 12-inch preventers are equipped with a bell nipple, a flow line bolted to the head and two kill lines connected to valves on either sides of the head (Figure 1). Only one line is shown for drawing simplicity. The

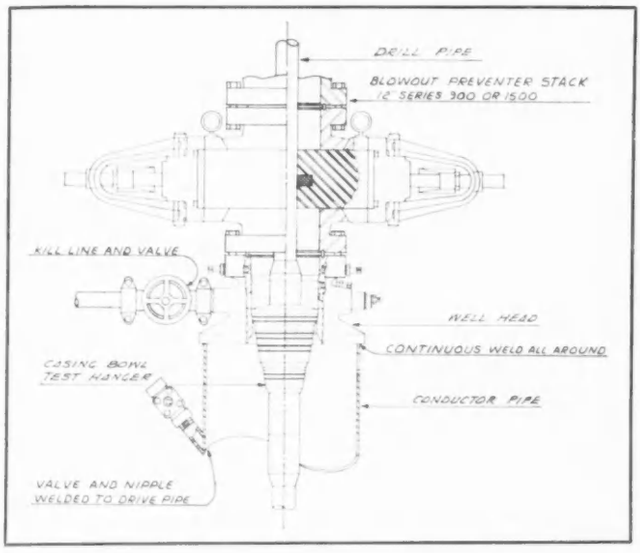

FIGURE 1—New wellhead assembly attached to the conductor pipe with the control equipment above the wellhead.

preventers are preferably bolted together as a single unit prior to the rigs arrival on location.

As a final step, the preventers are tested by lowering a test hanger into the lower bowl, closing the top preventer, and applying pump pressure through the kill line equal to the blowout preventers rated working pressure. After lifting the test hanger off its seat, the conductor pipe and all welds can be tested to rated pressure in the same manner.

The well is now ready to spud.

When advance preparations are made, these installations can be completed, the preventers tested, and the well spudded within three hours after an inshore barge-type rig is submerged on location.

Stage 2. Assuming that a 15-inch surface hole is to be drilled and 10¾-inch casing is to be set, a 12¼-inch conventional bit is screwed onto a drill collar string equipped with a special expansible blade reamer shortly above the bit. With blades collapsed the reamer and all parts of the drill string will pass through the restricted bore in the lower bowl which is $12\frac{11}{16}$-inch ID. (See Figure 2.)

When the reamer is below the head, applied pump pressure expands the blades to 15-inch OD. A 15-inch hole is then drilled to the desired depth. On the trip out of the hole, as well as all other times, the reamer blades are kept locked in the extended position to check the hole for gage. Just before pulling the reamer back through the head, the blades are hydraulically retracted to 12¼-inch OD. Recently a drill collar with eccentric reamer blades has been used as a satisfactory substitute for the expansible under reamer.

The hole is now ready to receive the 10¾-inch casing.

This technique has been used on a number of 15-inch holes varying in depth from 1,800 feet to 6,000 feet in several Gulf Coast fields.

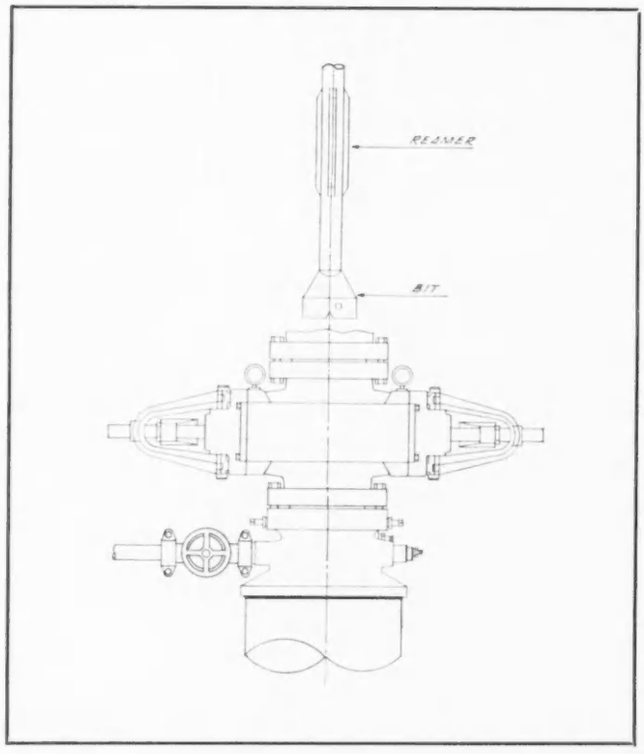

FIGURE 2—Drilling inside conductor pipe with new head assembly installed.

Stage 3. A common string of 10¾-inch casing has been run through the preventers and the special wellhead (see Figure 3). The only thing unusual about the string is that a boll-weevil casing hanger has been screwed into the collar of the next to last joint and the last joint screwed into the hanger. The hanger OD is less than the preventer ID, just barely permitting it to pass through into the head.

When the upper enlarged part of the hanger reaches the lower bowl in the head no further downward movement takes place. All weight of the 10¾-inch casing is suspended on the hanger thus making a tight seal be-

tween hydraulic packing rings on the hanger and the bowl.

After seating the hanger, the cementing head is installed on the landing joint of 10¾-inch casing as in conventional practice and circulation established with returns coming out the 4-inch outlet on the side of the drive pipe. The casing is cemented in the usual manner but with returns still coming out the 4-inch outlet.

Next, the landing joint of 10¾-inch casing is unscrewed (not shown) from the hanger using pipe tongs above the rotary on the derrick floor.

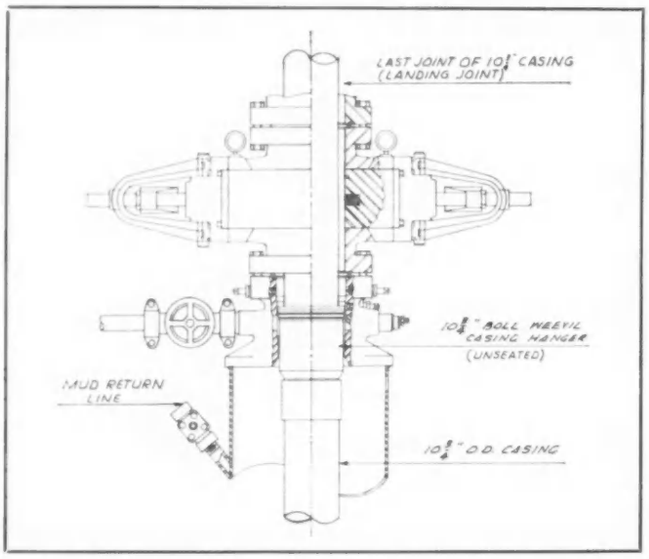

FIGURE 3—Running and landing 10¾-inch boll-weevil casing hanger.

Stage 4. A bowl protector, run through the preventers, is landed by means of a retriever screwed onto a joint of drill pipe (Figure 4). This protector serves two purposes: (1) it prevents drill pipe wear in the bowl into which the casing hanger on the next string of casing ultimately lands; (2) through use of a hold down wedge it becomes an integral part of a mechanical lock which securely fastens the head and conductor pipe to the 10¾-inch casing.

A 2-inch outlet is installed in the boll-weevil hanger, extending through the casing annulus and the conductor pipe to the outside where a valve (see Figure 5) can be installed. This is accomplished by:

- Cutting a hole in the conductor pipe with a cutting torch.
- Reaching into the annulus with a long hexagonal male wrench.
- Unscrewing a flat, external and internal flush, hexagonal male plug from the boll-weevil casing hanger.
- Inserting the 2-inch outlet with threaded male pin through the hole in the conductor pipe into the female threads in the hole in the hanger.
- Bucking the nipple up tight with a wrench on the B-20 outlet.

The outlet serves only as a means of access to the space between 10¾-inch casing and 7⅝-inch (or smaller) casing at a later point. If preferred, the outlet can be installed at the end of the well at the time of tree installation or omitted entirely.

Figure 4 shows the casing annulus full of cement. The cement was circulated back to the surface while performing the primary cement job on the 10¾-inch casing. Should it be necessary, a 1-inch pipe can be passed into the annulus through the 4-inch mud return line to a point 200 feet + or — below the head. The upper annulus can then be filled with cement. It is for this purpose that the 4-inch nipple and valve are installed on the conductor pipe at a sharp angle.

The 10¾-inch casing will always be in tension. If cement is circulated to the surface, the entire conductor pipe, cement and 10¾-inch casing riser becomes a form of pre-stressed concrete-steel column.

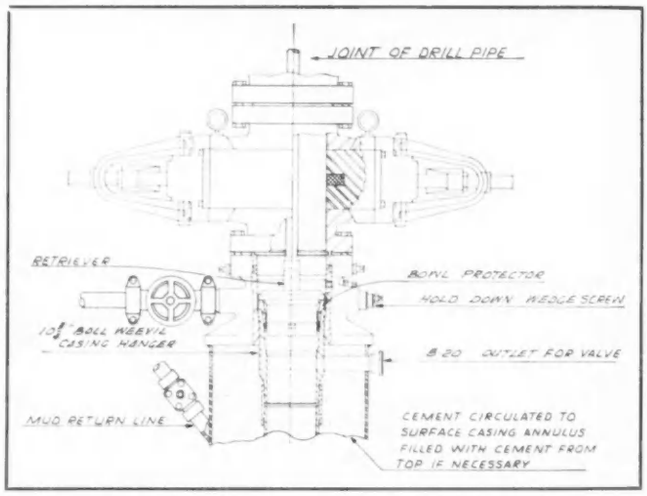
JOINT OF DRILL PIPE
RETRIEVER
BOWL PROTECTOR
HOLD DOWN WEDGE SCREW
10¾" BOLL WEEVIL CASING HANGER
B-20 OUTLET FOR VALVE
MUD RETURN LINE
CEMENT CIRCULATED TO SURFACE CASING ANNULUS FILLED WITH CEMENT FROM TOP IF NECESSARY

FIGURE 4—Here is shown the retrievable bowl protector installed and locked in place with hold down wedges. The retriever is removed and an outlet has been installed in the 10¾-inch boll-weevil casing hanger.

Stage 5. The tool which landed the bowl protector has been removed and the bowl protector locked into position by the four hold down wedges (Figure 5). Observe how the head is mechanically locked to the 10¾-inch casing by the wedging force of the hold down wedges through the bowl protector and 10¾-inch boll-weevil hanger to the lower bowl in the head.

A 2-inch valve is installed on the nipple which extends from the 10¾-inch casing outlet.

A test hanger is then lowered into a bowl in the top of the bowl protector and all seals tested to the working pressure of the blowout preventers in the same manner as described in Stage 1.

After raising the test hanger off its seat, pressure can be applied to test the 10¾-inch casing and 2-inch nipple. The test hanger is then removed.

Drilling is then resumed at this point.

A "nipple-up" job which consumes approximately one and one-half days rig time (plus or minus one-half day dependent upon the crew's efficiency) with conventional equipment can thus be performed with any crew using this new wellhead assembly in six hours. This includes the time to go in the hole with a bit and that which is necessary to grease the rig properly.

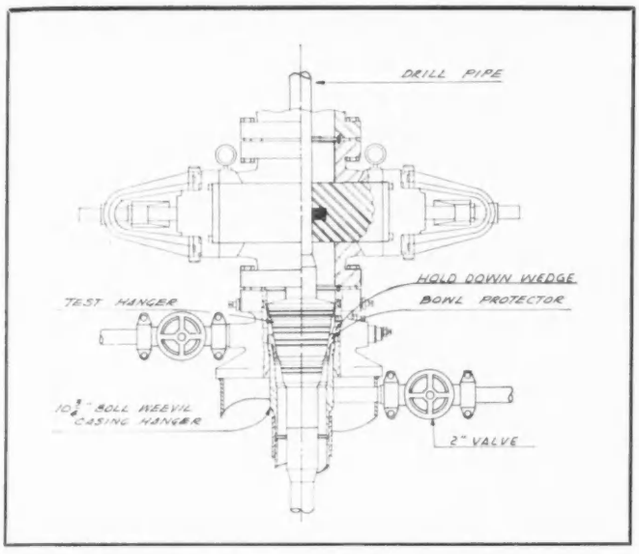

FIGURE 5—The entire head assembly is tested with the test hanger landed in the bowl protector seat.

Stage 6. The 9⅞-inch hole (or smaller) has been drilled and the retriever is shown being used to remove the bowl protector (Figure 6). This protector must be removed and hold down wedges retracted prior to running the next string of casing.

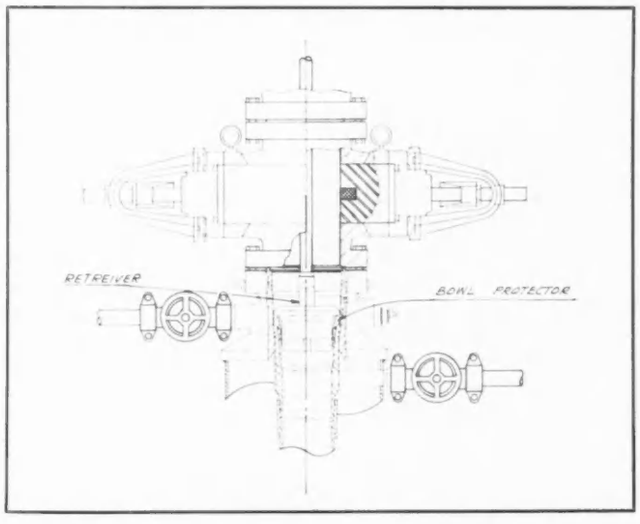

FIGURE 6—The retriever is used to remove the bowl protector.

Stage 7. A string of 7⅝-inch casing is landed using a procedure very similar to that described for the 10¾-inch casing in Stage 3. The 7⅝-inch boll-weevil casing hanger ultimately will rest in the bowl formed by the upper inside part of the 10¾-inch casing hanger (Figure 7).

The casing is cemented in accordance with standard practice. Mud returns can flow back to the pit through either the bell nipple or the kill line if the 7⅝-inch hanger is held slightly off its seat. Should the well start kicking, the hanger can be landed, locked in place with hold down wedges, and mud returns directed back to the pit through the 2-inch outlet in the 10¾-inch hanger.

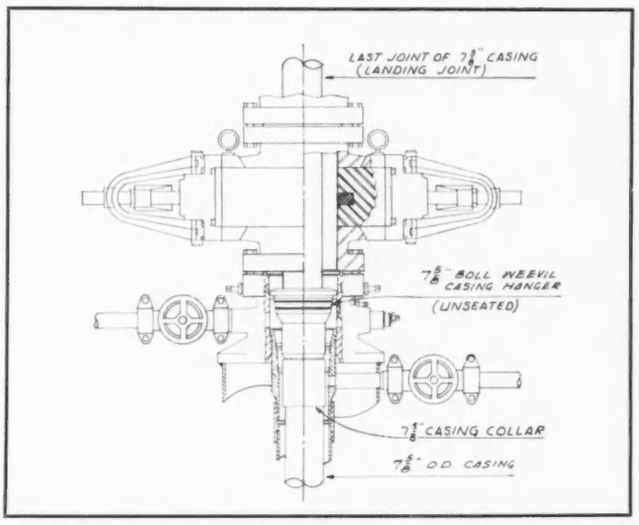

FIGURE 7—Here is shown the running and landing 7⅝-inch OD boll-weevil casing hanger.

Stage 8. When the plug hits bottom on the 7⅝-inch casing cement job, four hold down wedges are screwed into position over the beveled top of the 7⅝-inch boll-weevil casing hanger. The landing joint of 7⅝-inch casing is unscrewed from the hanger and withdrawn. All seals can be tested up to casing test pressure by closing the blind rams in the blowout preventers and turning on the pump.

The well is now ready for either drilling ahead or running logs and perforating for a completion.

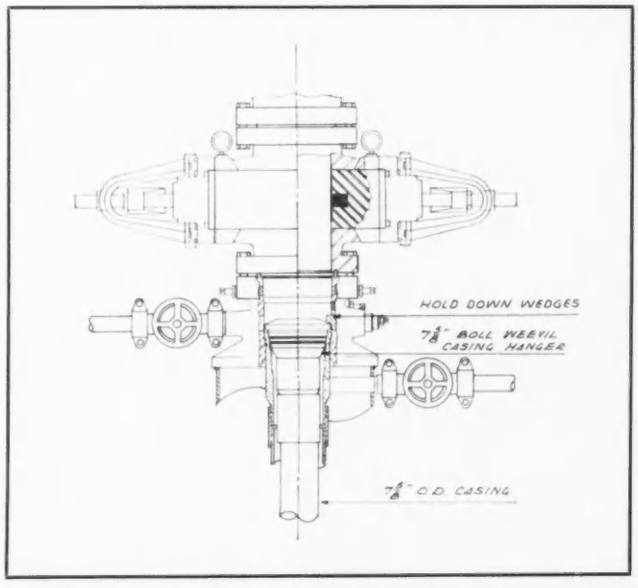

FIGURE 8—The 7⅝-inch boll-weevil casing hanger landed and locked in place with hold down wedges.

Stage 9. If it is necessary to test the hanger seals, head, and blowout preventers to a pressure higher than casing test pressure either at the time the 7⅝-inch is landed or at any subsequent point in the well's history, a test hanger may be landed in the 7⅝-inch boll-weevil hanger (Figure 9). Test pressure is again applied through the kill line as in the previous tests.

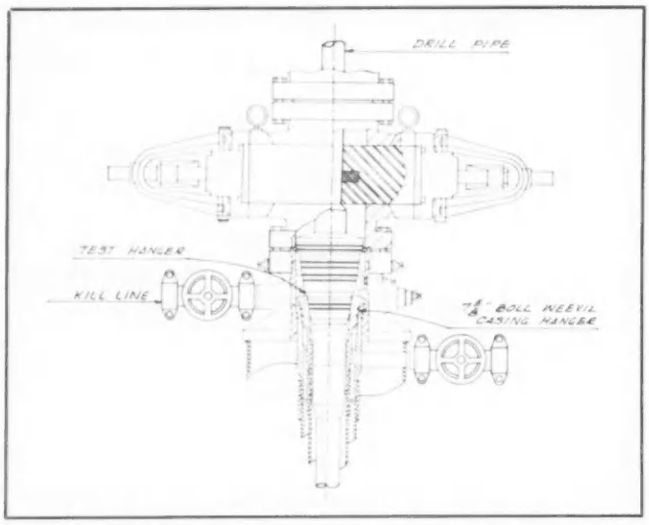

FIGURE 9—Before drilling ahead the test hanger is again test seated in bowl of 7⅝-inch boll-weevil casing hanger.

Stage 10. The tubing is shown going into the well following the logging perforating operation performed after stage 8 (Figure 10).

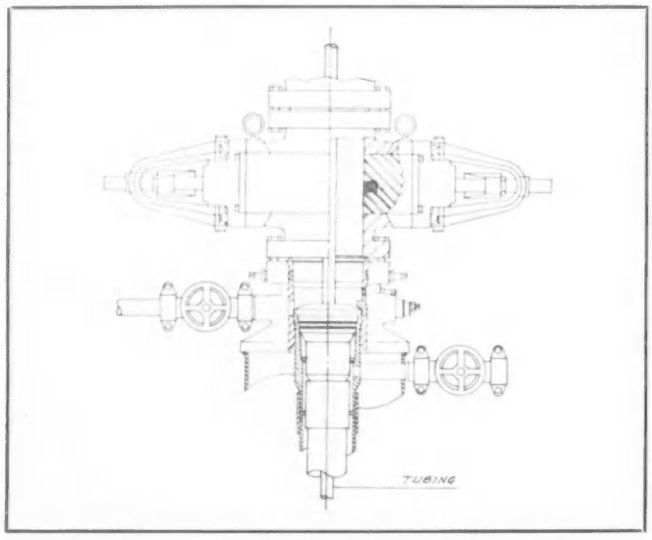

FIGURE 10—Here is shown the wellhead assembly while running tubing.

About the Author

Virgil D. Stone was graduated from the University of Oklahoma in 1949 with a degree in petroleum engineering. In 1945, he worked with The Ohio Oil Company as a roustabout. Following graduation from college he joined Gulf Oil Corporation as a petroleum engineer in the training program. With Gulf Oil Corporation he has held the following positions: Petroleum engineer, assistant area petroleum engineer, area petroleum engineer, district drilling engineer and his present position of area drilling foreman.

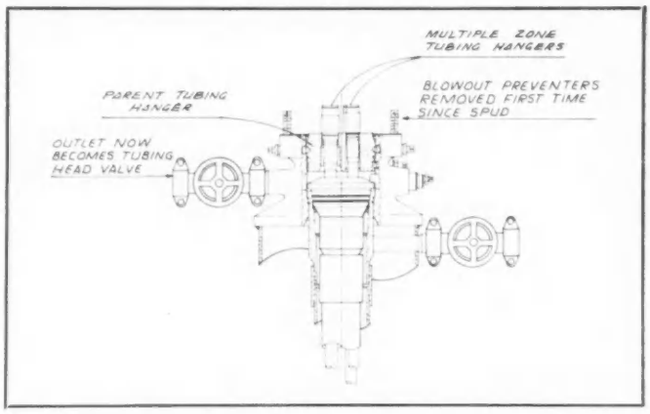
MULTIPLE ZONE TUBING HANGERS
PARENT TUBING HANGER
BLOWOUT PREVENTERS REMOVED FIRST TIME SINCE SPUD
OUTLET NOW BECOMES TUBING HEAD VALVE

FIGURE 11—The parent tubing hanger is landed and locked in place. Multiple zone tubing hangers, complete with back pressure valves are landed in parent tubing hanger. At this point, the blowout preventer is first removed since the original installation on the conductor pipe.

Stage 11. Two strings of tubing landed with multiple zone tubing hangers on a conventional parent tubing hanger have been seated in the top bowl of the wellhead assembly (Figure 11). Two side valve outlets in the head, formerly used for attaching kill lines, now become the equivalent of conventional tubing head valves. The tubing hanger can be tested if desired by applying pressure through the tubing head valves. The tubing hangers can be tested if desired by applying pressure through the tubing head valves.

The blowout preventers are removed at this point for the first time since the well was spudded.

Stage 12. In the final stage, a conventional tree is installed on top of the wellhead and tested in the usual

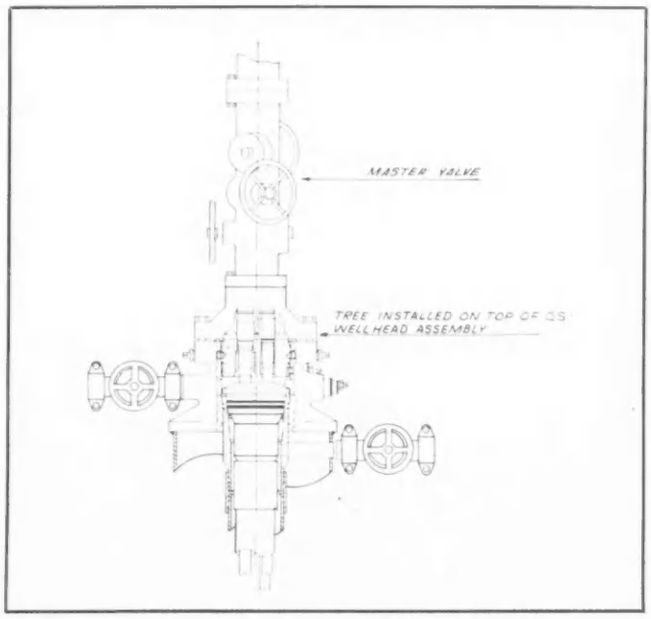

FIGURE 12—The master valve assembly is installed and ready for production.

manner (Figure 12). After displacement of the mud in the tubing strings, the well is placed on production.

—The End

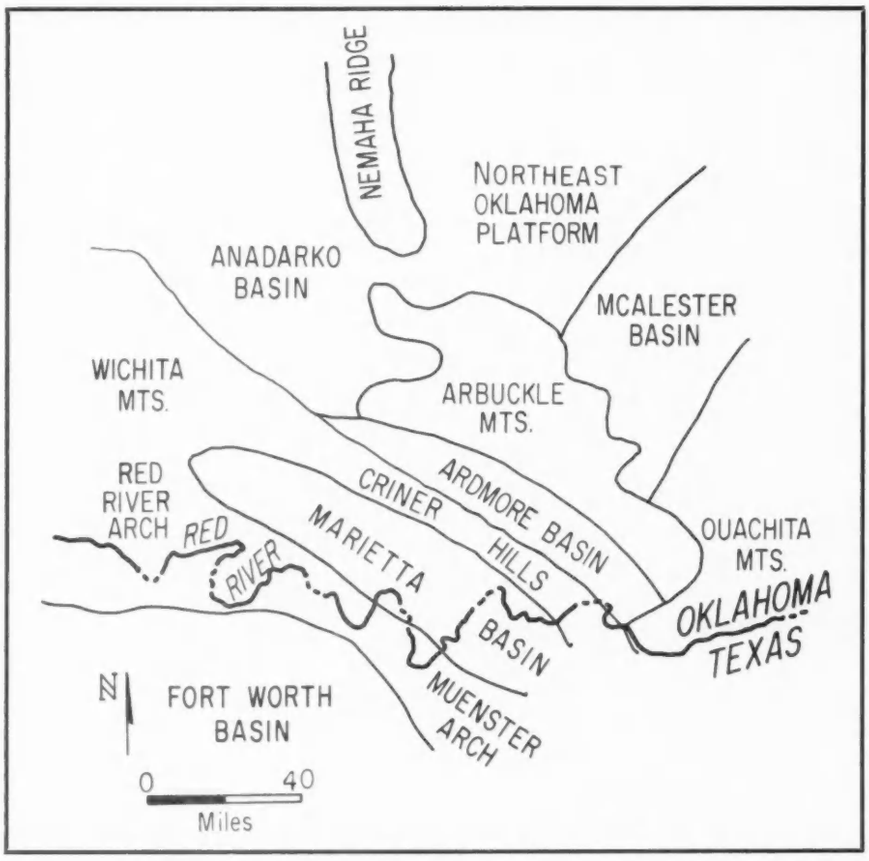

FIGURE 1—The Marietta Basin represents a crossroads of U.S. Mid-Continent drilling and sedimentary geology. Multi-pay productive potential and current drilling activity exceed in proportion the relatively small size of the Marietta Basin, which is ringed by the better known Anadarko Basin, Red River and Wichita highs, and other important regional geologic features.

Facies changes are key to Marietta Basin's oil future

Increased deep drilling provides new data on good multi-pay Pennsylvanian, Simpson zones

By C. C. Reeves, Jr., Staff Petroleum Geologist,
Texas Technological College, Lubbock

THE MARIETTA SYNCLINE straddling the Oklahoma-Texas border may be considered as the geological crossroads of the United States Mid-Continent region (Figure 1).

It contains multiple pay zones related structurally and stratigraphically to better-known surrounding geological provinces.

Acreage is tightly leased in expectation of future oil and gas reserves exceeding in proportion the Marietta Basin's relatively small size.

Prospects stem basically from many deformations, affecting the area, providing structures and unconformities favorable to accumulation of commercial hydrocarbon deposits.

The Pennsylvanian section holds good chances for future Marietta Basin discoveries, mainly in the far northwestern portion. Best Hoxbar prospects are in the lower section where overlap occurs around and on post-Deese-pre-Hoxbar highs. Several such features produce in southern Jefferson County along the basin's south flank. Similar structures are indicated along the Muenster Arch-Marietta Basin flank. Possibilities of truncated traps within the Chubbee-Confederate interval also should be investigated.

Expected future basal Deese sand production has been previously reviewed.[1] Many intraformational unconformities and characteristic lenticularity of individual sands indicate small but perhaps commercial stratigraphic Deese prospects.

Dornick Hills strata represent one of the better Pennsylvania prospects in the Marietta Basin. They lie on a truncated surface and pinch out to the northeast, southwest and northwest. Lithology is favorable. Good production is established in the Northeast Greenville area.

Attention is invited to Hoxbar-Deese prospects on the several low-value closures (regional gravity derivative map, color contours, Figure 2). These are in the western part of townships 6 and 7S R2W, parts of T8S R2W, T7S R2E and in townships 6 and 7S, R1E and R1W. The author does not advocate drilling such areas on gravity leads alone, but hydrodynamic studies of these sands might also aid in determining drillable prospects.

Pre-Pennsylvanian production has been generally hampered by inadequate means of inducing secondary permeability in Simpson and Viola limestones, despite sample and electrical log analyses and drillstem tests indicating commercial production in these formations in the Marietta Basin. However, continued successful development of Hunton production in the West Joiner City-Northwest Orr area and of basal Oil Creek sand pays at Southeast Marietta has shown the basin to be important out of proportion to its size.

McLish production was established in 1957 at Southwest Enville and

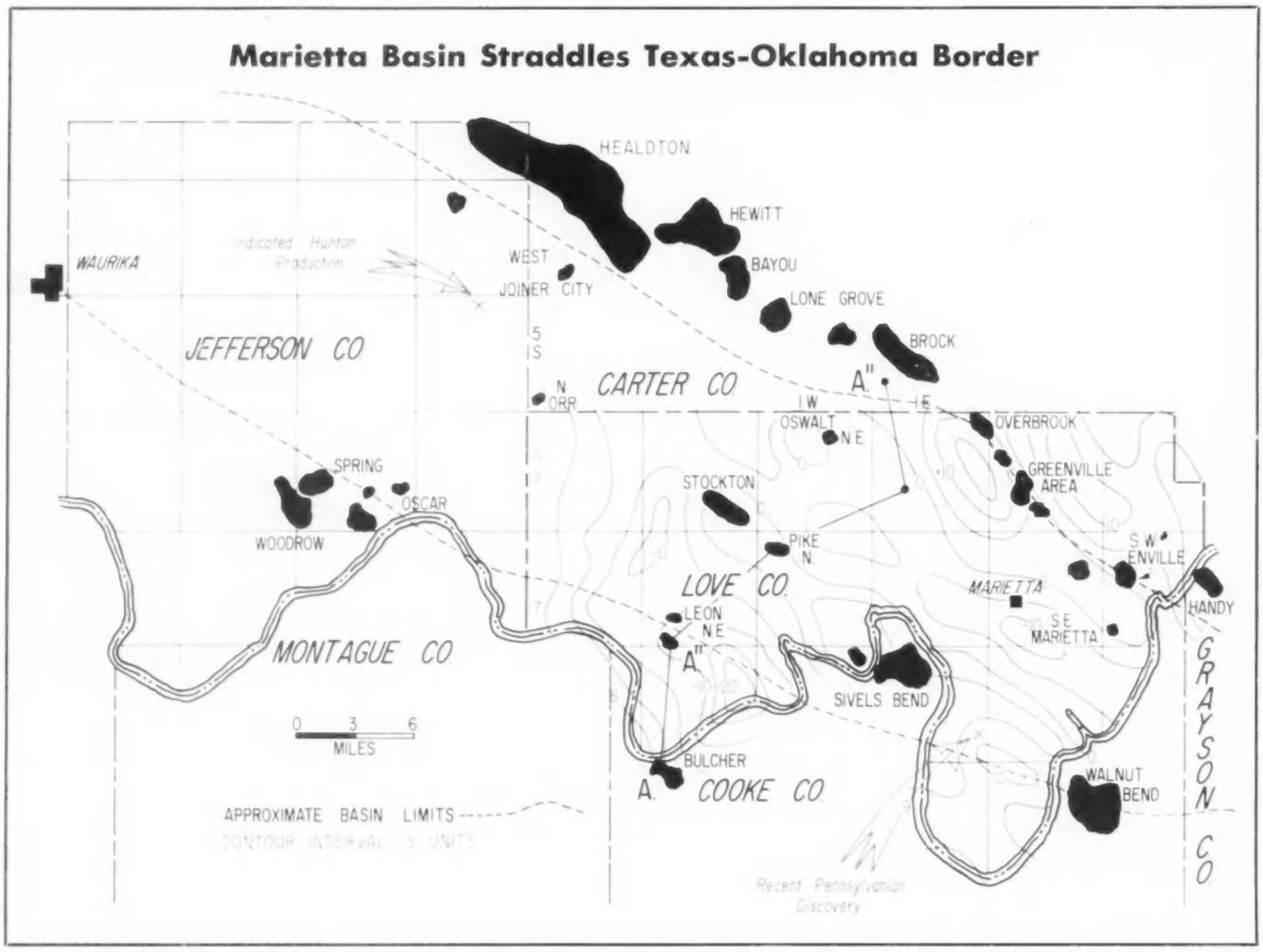

FIGURE 2—Oil fields lie along flanks, both inside and outside of basin limits. The major Healdton oil field is the largest in the area shown. Gravity coverage (color) of Love County indicates regional trends and more localized anomalies.

was enhanced in July 1960 by a 633 bopd McLish producer in Marietta field completed by Samedan Oil Corp. from the interval 11,778-11,948 feet.

The Arbuckle is the one near-virgin pre-Pennsylvanian group in the Marietta Basin. Arbuckle production usually is found when overlain by a short Simpson section. More recent discovery of Arbuckle pay in Northwest Noble pool, Cleveland County below a normal Simpson section has created an additional pre-Pennsylvanian prospect, at least in Love County. The best Arbuckle prospects in the Marietta Basin are in Jefferson County, where Arbuckle is overlain by a major unconformity. Only sporadic production has been found, usually along the southern basin flank.

Development. Intensive oil exploration along the basin flanks has continued for 50 years. But the oil search within the Marietta Basin trough has been very slow, with occasional short-lived spurts. A recent burst of activity was initiated by discovery of basal Oil Creek sand production at Southeast Marietta shortly after discovery of Southwest Enville field.

Still more recently, unexpected Hunton limestone production was found by Frankfort Oil Co. Woodworth Estate 1, S31 T5S R3W to bring in the Northwest Orr area. Few oil fields are found within the Marietta Basin trough. These two new discoveries and geologic studies tied in with data from important fields lying just outside the Marietta Basin reveal promising basin depositional and deformational conditions.

STRATIGRAPHY

Overlap relations are highly complicated by several regional and many intraformation unconformities. The sedimentary section found in the deeper parts of the basin was previously divided by the author into "depositional slices", each slice exhibiting some degree of deformation. The second youngest sedimentary unit, topped by the Arbuckle orogenic surface and underlain by the Wichita erosion surface, includes all Pennsylvanian strata. This unit exhibits evidence of the Muenster, Ouachita and Bostwick movements, and is the best known, least predictable, most confusing, and most productive of the entire basin.

Aerially, the Marietta Basin is divided into a broad, shallow part confined principally to Jefferson County, Okla.; a narrow, deep, much smaller part confined to Grayson County, Texas; and a larger intermediate portion, deep in the southeast and shallow in the northwest, lying principally in Love County, Okla. The shallow Jefferson County

part (Ringling Basin) exhibits truncated Arbuckle beneath the pre-Atoka unconformity; hence oil exploration has been confined principally to the lenticular sands of the Pennsylvanian veneer.

The deep southeastern part of the basin, its southern flank marked by faults bounding the Sandusky structure in Grayson County, and its northern flank disappearing beneath Cretaceous overlap, has been termed the Gordonville trough. This portion of the basin exhibits definite deep possibilities, but is continually bypassed because of small size and high deep drilling costs. Considerable drilling continues along the shallower Grayson County flank.

Fortunately, the intermediate, or Love County, portion of the basin exhibits a normal (though truncated) pre-Pennsylvanian section covered by a good thickness of post-Mississippian strata. Petroleum possibilities are proportionally greater in this portion of the basin.

Post-Pennsylvanian. Cretaceous strata, underlain by Permian Pontotoc, are the youngest found. No important Cretaceous or Permian oil or gas has been found in the Marietta Basin.

Pennsylvanian. Uppermost Pennsylvanian and the Permian Pontotoc is an interval of arkosic sandstones and red shales at least 2,200 feet thick along the Jefferson-Love County line. An undetermined thickness is present in northwestern Grayson County, but thinning takes place on the Muenster Arch until (in the Walnut Bend area) basal Cretaceous rests on upper Hoxbar. Post-Hoxbar strata are of little economic importance.

The Hoxbar lithologically consists of buff to gray shales and thin, fine-grained sandstones with several sporadic limestones. As the Hoxbar-Deese unconformity is approached, the shales become thicker and assume a maroon color; sporadic limestones are again present. The Hoxbar group attains its maximum thickness of nearly 4,300 feet in the southeastern Oklahoma part of the Marietta Basin, thinning therefrom in all directions by truncation, overlap, or both. Maximum thickness in the Texas portion of the basin has been estimated at 3,500 feet.

SYSTEM	SERIES	GROUP	FORMATION
Cretaceous	Comanche	Trinity	
Permian	Wolfcamp	Pontotoc	
			~~Arbuckle Orogeny~~
Pennsylvanian	Virgil	Cisco	
	Missouri	Hoxbar	Zuckermann Daube Anadarche Crinerville Confederate
			~~Muenster Uplift~~
	?	Deese	Chubbee Deese Maroon
	Desmoines		~~Ouachita Orogeny~~
	Atoka	Dornick Hills	~~Bostwick Uplift~~
	Morrow		~~Wichita Orogeny~~
	Springer	Springer	
Mississippian	Chester		Goddard Caney Shale
	Meramec		
	Osage		Sycamore
	Kinderhook		Woodford
Devonian	Ulster	Hunton	Bois d'Arc Haragan
	Niagra Albion		Henryhouse Chimneyhill
Ordovician	Cincinnati		Sylvan
		Viola	Viola
	Champlain	Simpson	Bromide Tulip Creek McLish Oil Creek Joins
	Canadian	Arbuckle	
Cambrian	Croixan		
		Timbered Hills	
Pre-Cambrian			

FIGURE 3—Stratigraphy of the Marietta Basin. Four disturbances during the Pennsylvanian complicated sedimentary relationships and also enhanced oil accumulation.

When a complete Hoxbar section occurs, it is easily identified by characteristic members. These are found along the northern flank of the basin and are (beginning with the youngest) the Zuckermann, Daube, Anadarche, Crinerville, and Confederate. Only the Daube and Anadarche are correlative over much of the basin, although the Confederate is widespread. Attempts to correlate like zones along the basin's south flank (Jefferson County) with the north flank Love County members met with fair success. South flank zones were named "lower lime", "lower mid-Hoxbar sand", "upper mid-Hoxbar sand", and "upper twin lime",

terminology well adapted to Hoxbar in most of the basin.

The lower Hoxbar lime zone, an oolitic, fossiliferous limestone which reaches maximum thickness of 800 feet in central Jefferson County, was correlated to the Confederate of the basin's north flank. Uppermost Hoxbar, a sequence of thin marine limestone separated by gray shales, is the "twin lime" zone. However, the author found the term "triple lime" more applicable because of widespread occurrence of a third lime member (the Anadarche).

The Hoxbar section beneath the "triple lime" zone and above the "lower Hoxbar lime" is essentially a gray shale section with two prominent sandstone zones. The upper mid-Hoxbar sand is correlative to the Crinerville zone of the north flank and also to the Piott sand of Grayson County. The lower mid-Hoxbar sand does not seem to have a north flank equivalent.

Along the northern flank of the basin poor development is found in the "triple lime" zone, the only recognizable members being the Daube and Anadarche. The Daube, lying about 400 feet above the Andarche, often loses character in the basin depths but is easily recognized along its flanks. The Anadarche zone along the northern flank measures from 100 to 200 feet in thickness. Its most persistent lithology is a thin, highly resistive limestone closely resembling the Daube.

The lower Hoxbar lime zone is also poorly developed in most of the basin, generally with 200 to 250 feet of Confederate zone present in the trough and only a few feet with the characteristic Confederate lime kick high on the flanks. The lower mid-Hoxbar sand is almost lost basinward but the upper mid-Hoxbar sand gains to a maximum thickness of 500 feet or more in the basin trough.

Within the basin proper and increasingly so toward the south flank, the Hoxbar varies in thickness, often at the expense of the basal rather than the uppermost section. The unconformity separating Hoxbar and Deese strata is of greater magnitude than is often realized. Though little evidence is found in the Criner Hills, the unconformable relationship exists high on the northern flank. To the south along the Muenster Arch, extensive post-Deese-pre-Hoxbar uplift is evident. Overlap of basal Hoxbar has long been recognized in southeastern Jefferson County and is well illustrated by examination of the section from Jefferson County (T6S R4W) to Stockton field.

A complete lower Hoxbar section is found in eastern Jefferson County but is absent in the Stockton field area, only nine miles to the southeast. The fact that Stockton lies on trend with the Jefferson County section suggests uncomformable overlap, but the amount of section missing indicates more than mere overlap. The possibility of faulting or of an island in early Hoxbar seas is consistent with the geologic picture to the southwest. If an old topographic high did exist, breaching did not take place until shortly before Stockton sand deposition. This same general picture is found in T6S R4W, where the upper mid-Hoxbar sand section overlaps the early Woodrow positive, with the "triple lime" zone finally breaching it.

The Hoxbar-Deese contact along the northern flank occurs immediately beneath the Confederate limestone and over the Chubbee sandstone, but in the trough the contact's position is debatable. Both the Chubbee and Confederate undergo lithologic changes. Additional section appears, boosting the Confederate-Chubbee interval to over 700 feet in parts of southwestern Love County. The contact is usually placed at the base of the Confederate zone, indicating thinning of the Confederate-Chubbee interval by truncation rather than by overlap. But since Bradfield found the basal Missouri of the Grayson County area to be " . . . older than the Confederate limestone of the Ardmore basin . . .", overlap is suggested.

The Deese section of the Gordonville trough is divided into the basal "Gray Strawn," an overlying "Red Strawn," and the "upper Gray Strawn" by most geologists.

The Gray Strawn is mainly gray shale with thin marine limestones and occasional sandstones. It occurs mainly high on the Muenster Arch. Apparently, only a remnant of Gray Strawn occurs in the Oklahoma part of the basin since only 60 feet is found in northernmost Cooke County.

In northern Grayson County, the Red Strawn, whose top correlates with the top of the Deese Maroon in Love County, makes up most of the Deese section. This Deese Maroon-Red Strawn top is often considered as the Missouri-Desmoines boundary. Approximately 400 feet beneath the Red Strawn top is a 700-foot shaly sand section which may be correlative to the Rocky Point conglomerate (Oklahoma Deese section, Ardmore Basin). This zone is the Hudspeth sand zone of northern Cooke and Grayson counties.

A gray shale overlies the Red Strawn. This interval may measure 1,400 feet thick. Upper Gray Strawn is generally divided by two 200-300 foot sandstone zones; the lower is probably correlative to the upper Lone Grove sand series of the basin's north flank.

The many producing sands of the lowermost Red Strawn of Cooke and Grayson counties—Snuggs, Ramsey, Best, Atkins, and Winger disappear northwestward, although Deese sand production at Stockton is tentatively correlated to Grayson County's upper Hudspeth sand zone. Generally, the best Deese marker in Love County is the top of the Deese Maroon.

The Deese-Dornick Hills contact is easily established by radical lithologic change. Lowermost Deese in almost all of the Oklahoma part of the Marietta Basin consists of maroon shales with associated sandstone and gray shale, while in the north Texas portion shales of the Gray Strawn predominate. There is always an easily recognizable lithologic change to the coarse-grained limestones of the underlying Dornick Hills.

Dornick Hills group. Uplift of the Criner Hills during Springer and Morrow time led to deposition of thousands of feet of strata north of the Criner Hills but apparently little to the south in the Oklahoma portion of the Marietta Basin. Pre-Atoka Dornick Hills (Morrow) generally is confined to the Gordonville trough. The Oklahoma part of the basin exhibits only a veneer of post-Morrow strata. Springer beds seem to be generally absent, though their presence is suspected in the Gordonville trough.

After Morrow time, the Criner Hills area experienced the resurgent Bostwick uplift as evidenced by the flanking coarse Atoka conglomerates and limestones. In the southeast part of the basin Atoka strata consist of

hard silicious limestones, sandstones and shales which thin toward the Muenster Arch.

But in most of Love County, a section of thin limestones, small conglomerates, conglomeratic or coarse-grained limestones, and occasional spotty sandstones underlies the Deese. This material is almost certainly Atoka age Dornick Hills, but presence of unconformities both above and below plus poor correlation to known members make it difficult to assign an upper, middle, or lower age.

Although original distribution of Dornick Hills strata over south-central Oklahoma and northeast Texas is unknown because of erosion due to uplift at the end of Dornick Hills time (Ouachita orogeny), presence of Bostwick-like material in much of Love County shows inundation of the basin by mid-Dornick Hills time. Approximately 4,000 feet of Dornick Hills, both upper and lower, is suspected in the Gordonville trough.

However, the Dornick Hills remnant exhibits a maximum thickness of only 1,200 feet in the Sherman, Texas area and only 60 feet in the Walnut Bend area. Thinning takes place to the northwest as evidenced by 550 feet in the Pike field and only 480 feet at Stockton. Nine miles northwest of Stockton, basal Deese Maroon rests on pre-Pennsylvanian.

Mississippian. Four formations comprise the Mississippian section in the Marietta Basin. These are (beginning with the youngest) Goddard, Caney, Sycamore and Woodford formations.

Goddard formation. There is a general absence of Goddard strata throughout the Oklahoma part of the basin, though the Texaco 1 Dexter, S7 T7S R3E, cut similar material. Presence of Goddard is suspected in the Gordonville trough.

Caney formation. A varying thickness of Caney shale occurs in Love County, usually about 600 feet along the northern flank, but truncation takes place to the southeast (182 feet in Pasotex Brannan 3, S30 T7S R3E, and 140 feet in the California Brannan 1, S30 T7S R3E) and to the northwest.

The Caney increases in thickness northward. It is a blue to gray-black, micaceous and calcareous shale. Occasionally, it may be mistaken for Woodford, especially when phosphatic/calcite inclusions are present.

The Sycamore limestone outcrops along the basin's northern flank in Love and Carter counties. Thickness and lithology vary. Lithology changes from an arenaceous limestone in the northwest part of the basin to a shaly limestone with sandy lenses in the southeast.

Subsurface identification from characteristic off-white fracture planes and stratigraphic position is definite. Sycamore thickness varies from 100 feet near the Carter-Marshall County line to a five-foot exposure in the Arbuckle Mountains. Some wells in southeastern Love County cut as much as 750 feet of Sycamore, but this is attributed to thrusting and steep dip; normal thickness in the basin approximates 400 feet. The Sycamore is a minor producer along the north flank of the Marietta Basin at Northeast Greenville and Southwest Enville.

Mississippian-upper Devonian. Woodford formation. A 400-foot section of Woodford shale, the southern Oklahoma equivalent of the Chattanooga shale of the southeastern U. S., occurs in Grayson County, and 325 feet is found in southeastern Love County. Normal thickness in the central part of the Marietta Basin approximates 225 feet. The Woodford is a gray-brown to black, siliceous to waxy, highly organic shale which exhibits *Sporangites* inclusions, making it an easily recognized formation. In southern Oklahoma the Woodford produces in the basal Misener sand, several miles outside the Marietta Basin.

Silurian-Devonian. Hunton group. The Hunton is divided into four series, but unlike Pennsylvanian nomenclature, the group is best known by individual formations rather than by series names. Uppermost Hunton is composed of two formations, the Pinetop chert and the underlying Frisco limestone. Both are extremely limited in southern Oklahoma. Neither has been identified nor is expected to exist in the Marietta Basin.

The lower Devonian portion of the Hunton consists of Bois d'Arc limestone and the underlying Haragan marl. The Bois d'Arc has a limited extent. It is only 90 feet thick at type locality. Erosion at the end of Hunton time has in many places removed upper Hunton as well as the underlying Sylvan shale. Silurian members are Henryhouse and basal Chimneyhill formations.

The 200 feet or so of Hunton found in the Criner Hills area is thought to be Silurian. Younger Hunton is found to either side, though no Hunton has been identified south of Red River. The Hunton group is the thinnest stratigraphic unit found in the Marietta Basin, though 605 feet is found in the Southwest Enville area due to steep dip and thrusting. Because of the short section, little effort is made to identify Hunton formations. Yet the Magnolia Stewart well, S7 T6S R2E logged Bois d'Arc at 2,640 feet, Haragan-Henryhouse at 2,680 feet, and basal Chimneyhill at 3,232 feet.

The Hunton group is a white to gray, arenaceous and glauconitic limestone. Although basal Chimneyhill exhibits three different zones in other areas it is represented only by a finely crystalline, micaceous limestone in Love County. During the last few years the Hunton has become an important producer in the Marietta Basin. In 1953 Hunton production

Seismograph crew activity . . . historically has been an accurate indicator of the trend of wildcatting in the U. S., with exploratory well totals rising or falling regularly four years after a rise or fall in seismic crew months totals. (World Oil, April 1961, Page 72). Similar trends in other countries would forecast more wildcatting in 1962-1964 in Argentina, Libya, and all Africa, based on sharp increases in seismic crew months in 1958-1960. Conversely, fewer wildcats could be expected in 1962-1964 in Venezuela, Colombia, West Germany and Japan, considering sharp decreases in seismic work in 1958-1960.

While the SEG statistics are complied for the Free World only, mention is made of a published figure of 400 seismic crews in Russia as of May 1960. The Soviets reportedly plan to expand their active seismic crews to 1,200 by 1965. World Oil, August 15, 1961, Pages 74-75)

was established at West Joiner City, the first important pre-Pennsylvanian production in the basin.

Ordovician. The Sylvan shale is one of the distinctive subsurface stratigraphic units in the Marietta Basin. It is the first of many blue-green, laminated pyritic shales to appear. The Sylvan typically changes in its lower 100 feet to a dense, brownish, dolomitic shale which gives the distinctive resistivity "kick" immediately over the Viola top.

In the Criner Hills area approximately 200 feet of Sylvan occurs. In the southeast part of the basin thickness ranges from 150 to 480 feet. This variation is due to faulting and perhaps also to flowage.

Viola group. The Viola limestone is one of the best-known units of the stratigraphic column, principally because of frequent oil shows and its normal 800-900 foot thickness. The Viola is a coarsely crystalline, dark brown limestone with numerous glauconitic and white or "milk" chert inclusions. A middle shaly member is often found. Viola thickness ranges from 150 feet outside the basin flank to nearly 1,000 feet in northern Grayson County.

Several isolated cases of non-commercial Viola production are known within the basin. Recently commercial Viola production was established close to the northern flank of the basin in S31 T6S R3E (Pan American Merrick Unit.)

The Simpson group with its five members, Bromide, Tulip Creek, McLish, Oil Creek and Joins and related sands aggregate about 2000 feet of section. Members are discussed separately, both because of their importance as oil producers in Oklahoma and their probable future producing importance within the Marietta Basin.

• The Bromide formation is the most fossiliferous Simpson member and one of the most productive, though not necessarily in the Marietta Basin.

Thickness approximates 425 feet in the central part of the basin, increasing to the south where a 500-foot section is found. The Bromide in the Marietta Basin has either an upper 150-foot gray-brown, fine to medium crystalline limestone or a limy shale section. This upper part is underlain by 300 feet of waxy green laminated shale with thin lentils of cream-colored coarse-grained limestone. The basal member (when present) consists of a fine-grained calcareous white to gray sandstone.

In Grayson County, the top of the Bromide is usually placed at the top of the first green shale underlying the Viola, although it is suspected that what is often termed lower Viola is actually upper Bromide limestone. Some Bromide is found along the northern flank of the basin at Southeast Enville.

The five basal sandstones of the Simpson group exhibit an erratic distribution. In the Arbuckle Mountain area the Bromide, McLish and Oil Creek sands are widely distributed. Tulip Creek and Joins sands occur in the western and central parts only. In the Criner Hills, most Simpson sands are missing. Where present they show very poor development. Generally the Bromide, McLish and Oil Creek sands disappear to the northwest, being completely absent in T5S R1E. Conversely the Tulip Creek sand thins southeastward, becoming the only Simpson sand absent in that part of the basin.

• The Tulip Creek formation is considered the most localized of the five Simpson formations, yet it enjoys good distribution within the Oklahoma portion of the Marietta Basin where it consists mainly of light green, splintery shales which partly resemble the lower Bromide shales.

However, Bromide shales are laminated rather than splintery, and waxy rather than dull. About 400 feet of Tulip Creek occurs along the Carter-Murray County line but thins to 300 feet within the basin. Thinning apparently takes place southeastward since Tulip Creek is not recognized in the Grayson County portion. Basal Tulip Creek is conspicuously absent in most of Love County.

• The McLish formation contains less green calcareous shale and more limestone than any of the other Simpson formations.

In Love County the McLish has three members. The upper is a light colored, coarsely crystalline, chalky and arenaceous limestone, which may suddenly change to a soft, green, calcareous shale with interbedded limestone stringers. The middle McLish is a chalky, coarsely crystalline, extremely fossiliferous limestone with characteristic large sand grain inclusions. The basal McLish sand member is well developed in most of Love County. This sand measures 50-100 feet in thickness. It loses much of its initial porosity and permeability by calcareous cementing.

In the Texas part of the basin, the McLish consists of three ostracodal limestones correlative to the previous three Oklahoma members. McLish thickness approaches 475 feet in the Arbuckle Mountain area and up to 600 feet along the southeastern flank of the basin. Normal thickness within the basin is considered to be 390 feet.

• The Oil Creek formation has in recent years become the most important oil-producing Simpson formation in the Marietta Basin. In 1957 the discovery of basal Oil Creek sand production high on the southeast flank at Southwest Enville spurred an exploratory effort which continues to gain momentum. Later discovery of the Southeast Marietta field brought Simpson production well within basin limits to set off a lease play in the basinal trough which now finds virtually all of Townships 7 and 8S R1 and 2E tightly leased.

The Oil Creek is the thickest of the five Simpson formations, measuring 675 feet in the Arbuckle Mountains, approximately 1,000 feet in the Oklahoma part of the basin, and 800 feet in Grayson County. Division into three distinctive zones is easily accomplished.

The upper zone, about 200 feet thick, is a coarsely crystalline, silty limestone termed the "Birdseye". On the Texas side the McLish-Oil Creek contact is put within this massive Birdseye member. The Oil Creek part is limited to the non-porous, non-oolitic lower section. Beneath the Birdseye is nearly 800 feet of interbedded green and black calcareous shale, changing in the lower few hundred feet to soft gray-green shale. The section is interbedded with several thin ostracodal limestones.

The lower 200-foot zone of Oil Creek is divided into an upper, coarsely crystalline, dark arenaceous and pyritic limestone with interbedded ostracodal zones and the basal Oil Creek sand, a fine to very fine-grained, calcareous and well

consolidated member. In Grayson County the basal Oil Creek sand is a well sorted and rounded unit with its upper and lower parts tightly cemented by carbonate.

• The Joins is divisible into three zones as drilled in the Oklahoma part of the Marietta Basin. The upper 50 feet is coarsely crystalline, black and gray arenaceous limestone with large quartz inclusions, correlating to 60 feet of fossiliferous limestone found across the Texas line. The middle zone, about 180 feet thick, is coarsely crystalline, light gray to black, fossiliferous limestone and/or dolomite. The basal zone, about 50 feet thick, is of interbedded olive drab shale and coarsely crystalline, dark to light, arenaceous limestone and dolomite. To the south these two lower zones change to predominately dolomite. Thinning apparently takes place to the southeast —only 200 feet is present in Grayson County.

Cambro-Ordovician. Pre-Simpson strata of the Marietta Basin consist of at least 7,600 feet of dolomitic limestones, limestones, and shales. About 6,000 feet is Arbuckle group strata, about 5,600 feet of which is of lower Ordovician age. Rocks of the lower Arbuckle group and underlying Timbered Hills are not known in the Criner Hills region but no doubt occur at depth. Knowledge of the character of Arbuckle and Timbered Hills groups south of exposures in the Arbuckle Mountains is generally lacking, though in northwestern Jefferson County the eroded Arbuckle surface lies below the pre-Atoka unconformity.

STRUCTURE

Structural aspects of the Marietta Basin have been covered in previous publications and will be dealt with very briefly here.

Regional structural history. Pre-Pennsylvanian Paleozoic deposition occurred mainly under quiescent conditions. Continual Pennsylvanian pulsations caused rapid erosion and deposition in and around the Marietta Basin. The final Arbuckle orogeny occurred at the end of Virgil time and pushed with great force from the northeast, complicating existing structures and causing many thrusts which parallel the northern basin flank.

Regional structure is well shown by the regional gravity derivative map (color contours, Figure 2). The Criner Hills arch is well defined as the high-density positive separating the Ardmore and Marietta basins by the 0-unit contour. The Marietta Basin also is well defined by the migrating 0-unit contour. Northwest-southeast trending low values define the basin's trough. The pre-Pennsylvanian high along which the Stockton, Pike, Sivels Bend, and Walnut Bend fields occur is clearly defined by the extreme northwestward nosing of the 0-unit and 5-unit contours north of Gainesville.

Local structure. Although several structural anomalies are known within the Marietta Basin, only one major anticlinal structure is known. This trend parallels the basin flank from Walnut Bend northwest past Stockton, mainly in western Love County. Primarily a pre-Pennsylvanian flexure, the trend apparently influenced Pennsylvanian deposition so that 300 feet of closure exists in overlying Pennsylvanian strata. Production has been found within this closure (Stockton and North Pike fields). Several small post-Deese-pre-Hoxbar topographic highs, long productive, are in southeastern Jefferson County, high on the basin's southern flank and close to the Muenster Arch.

Elsewhere, the Marietta Basin shows a lack of structure, at least when investigated by normal methods. However, the regional gravity derivative map (Figure 2), a technique emphasizing local gravity anomalies, suggests additional local structures, most of which are uncondemned by drilling. Such closures are suggested in T7S R2W; T8S R2E; and T7S R1E.

Faulting occurs in several areas and has been responsible for such accumulations as Thackerville and Sivels Bend. Reed's pre-Atoka paleogeologic map of the basin indicated most of the larger structures but also shows how local faulting can suddenly appear.

(Three cross-sections graphically showing some of the facies changes across the Marietta Basin described in this article are tentatively scheduled to be published in a future issue of WORLD OIL. These sections traverse the segments A-A'-A" on Figure 2—Editor's note.)

About the Author

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ACKNOWLEDGMENTS

The author is indebted to numerous geologists and producers operating in the Marietta Basin area for their cooperation. Release of the regional gravity derivative map by Exploration Surveys, Inc., is also acknowledged.

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This new type dual completion reduces costs, boosts recovery

Unique wireline retrievable tool permits commingling of production downhole, accurate determination of contribution from each zone

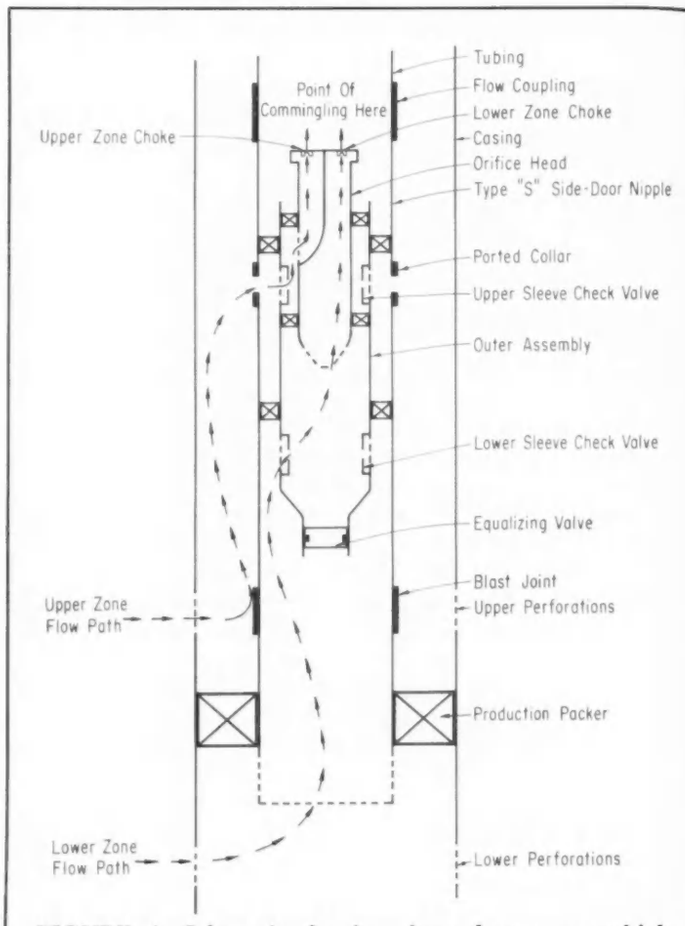

FIGURE 1—Schematic drawing shows how new multiple completion wireline tool works. Note that production is effectively separated until commingled above chokes.

By J. W. Hodges, Administrative Engineer,
Sun Oil Company, Beaumont, Texas

Sun Oil Company has developed and is currently using a new wireline multiple completion tool to produce two separate reservoirs simultaneously through a single tubing string. The multiple completion tool has been successfully installed in a well in Allen Parish, Louisiana since March 1960. Annual gross income from the well has increased $48,400.00, with a net reduction in operating costs. Another tool was set recently in a well in St. Mary Parish. Five additional Sun installations in Louisiana are in progress.

Major advantages in using this tool to commingle production from separate reservoirs in one string of tubing are:

- Excess energy from one zone can be used to lift production from a weaker well.
- Current income can be increased and well costs reduced sharply.
- Completions can be made economically in doubtful looking zones apparently not worth the additional investment required for a twin string dual.
- When completed and commingled with a good well, weak zones can be produced to depletion without artificial lift.

All these factors contribute to an increase in ultimate recovery.

Operation of the downhole commingling tool is shown schematically in Figure 1. The lower zone flows up the tubing, enters the tool through a slotted section in the outer assembly, flows around a resilient check valve and enters the tube of the orifice head assembly where it is choked. Lower zone production then is commingled with upper zone fluid in the tubing above the tool.

The upper zone flows up the casing and into the tubing through a ported collar. It then enters the tool through another slotted section in the outer assembly, flows around the upper resilient check valve into the annulus around the tube, is choked and then commingled with the lower zone.

Pack-off elements maintain separation of the two zones up to the point of regulation. The system thus becomes analagous to surface commingling, as shown in Figure 2, except that the point of pressure reduction is located in the logical place—at the bottom of the well where energy in the released gas can be utilized. This energy is wasted when surface chokes are used.

The multiple completion choke assembly is shown in Figure 3. The outer assembly, shown on the left, is run with wireline tools and is located and locked in a type S side-door choke landing nipple. The resilient check valves, shown opposite the relative positions they occupy within the tool, prevent flow from one zone to the other. The orifice head, shown on

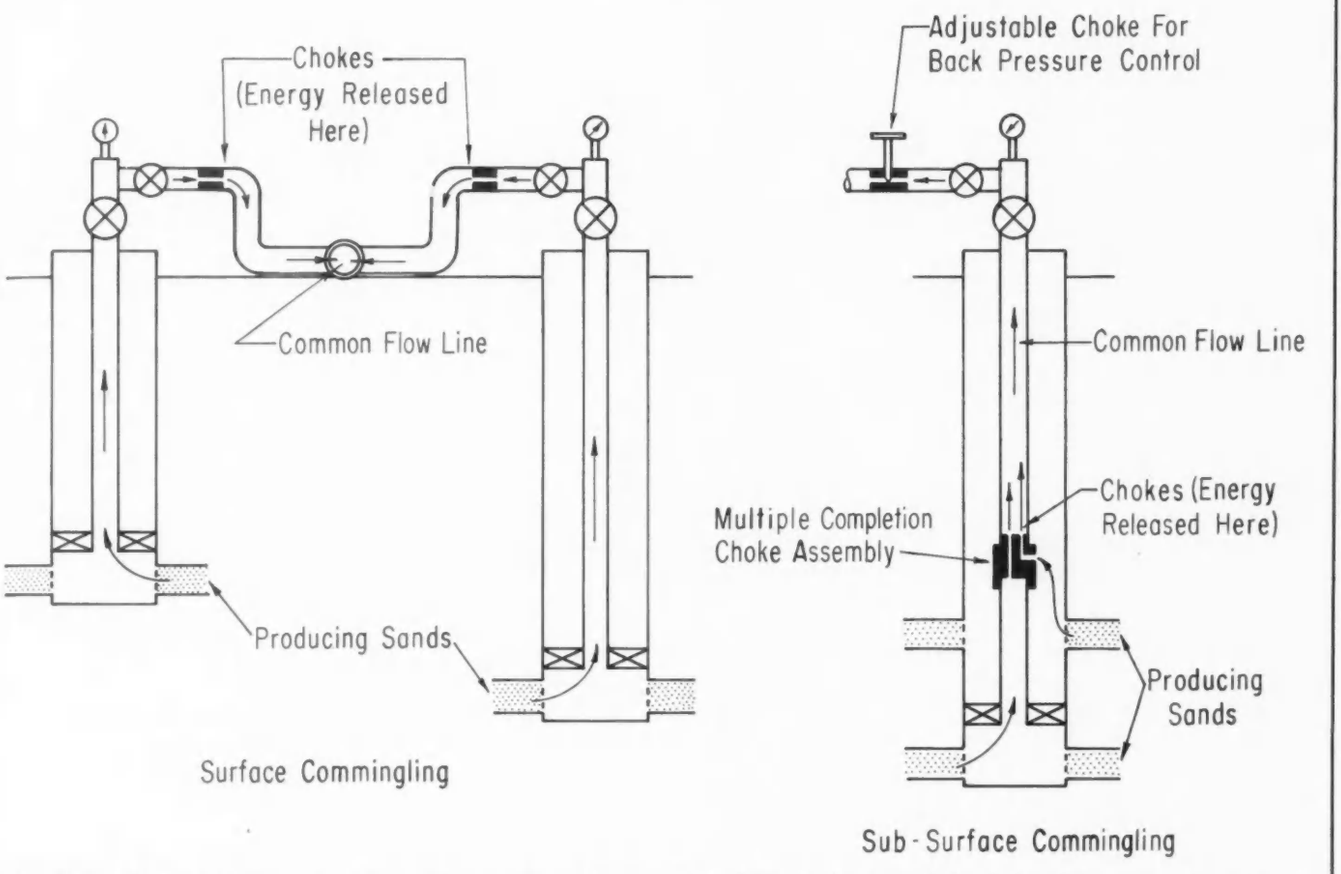

FIGURE 2—Downhole commingling is analoguous to surface commingling except that the pressure reduction is accomplished at the bottom of the hole where energy in released gas can be used.

the right with the two tungsten carbide choke beans, is run separately and is locked in the outer assembly.

Steps involved in installation of the assembly are illustrated in Figure 4. When a choke change is required, the orifice head is pulled leaving the outer assembly in place. The check valves in the outer assembly prevent flow from one zone to the other even with the orifice head removed from the well. Required wireline operations are relatively simple and have become routine.

The well in Allen Parish, prior to installation of the multiple completion choke assembly, was producing as a concentric dual completion with the upper zone flowing in the annulus between the 2⅜-inch tubing and 5½-inch casing and the lower zone flowing through the tubing. The upper zone, a high ratio oil well, is completed through perforations 8,067-70 feet. The lower zone, a gas well, is completed through perforations 8,448-52 feet. The conversion to commingled flow was made with wireline tools by pulling the side-door choke located at 8,000 feet and replacing it with the multiple completion choke assembly.

The subsequent increase in production resulted from decreased gas-liquid ratios and an increase in lower zone productivity. Operating costs were reduced through elimination of the surface heater (by the bottom hole choke effect) and because gas from the lower zone no longer requires compression to enter the sales line. Periodic production and packer leakage tests required by the Louisiana Department of Conservation have been performed on a routine basis. *There has been no evidence of communication between the two reservoirs.*

Hardness of the choke material and location of chokes below paraffin deposition depth have eliminated choke erosion and plugging. This has resulted in accurate determination of the contribution from each zone. Table 1 reflects the consistency of production rates through the 5/64-inch choke serving the upper zone well. The same 5/64-inch choke was used in each test and operated in the well from April 1, 1960 until replaced with a different size choke in January 1961. The choke was not cut when replaced.

The tests were used as a basis for allocating production to each zone, and were obtained by inserting a blank choke bean in the orifice head opening communicated to the lower zone. (This again is analagous to the conventional surface commingling system shown in Figure 2 and is the same thing as closing the wing valve on one of the wells while producing the other on test.) When a stabilized upper zone rate had been established,

the orifice head was round tripped and a stabilized test made with both zones producing. The predetermined rate of gas and liquid production from the upper zone was subtracted from the total. The remainder was allocated to the lower zone.

The rate of production from the upper zone is not affected by commingling as flow through the choke is not in the critical range. Flow from the lower zone is in the critical range and can be regulated with a surface choke. Producing characteristics of the two zones determine method of control and test procedures.

Conditions imposed by use of the multiple completion choke assembly afford maximum opportunity for accurate flow rate control. In any system involving commingled production, the accuracy of determining the contribution from each zone depends on accurate flow rate control. The chokes in the multiple completion tool —more resistant to erosion and unaffected by paraffin deposition—will perform more efficiently than surface chokes. The multiple completion tool dual, therefore, will provide for more accurate allocation than can be obtained with conventional surface commingling.

Multiple completion choke beans are undergoing a severe abrasion test in one of Sun's wells in Chambers County, Texas. In an attempt to solve acute problems associated with high pressure well completions, the multiple completion tool has been modified to single zone flow and is being used as a bottom hole choke. Surface tubing pressure of this well has been reduced from 7,300 psi to 4,100 psi.

A high differential type leak, probably a tubing thread leak, which had existed before the installation was made, has been stopped. Production through the choke to date has been 492,000 Mcf of gas and 2,400 barrels of condensate, a total effluent in excess of 24 million pounds. There has been no discernible cutting of the choke.

If this experiment proves the feasibility of pressure reduction as a solution to the problems associated with producing abnormally high pressure wells, hazards to personnel will be reduced and the terrific costs incurred in working over such wells can be avoided.

The dual oil well in St. Mary Parish, an inland water location, is completed 14,236-39-feet and 14,025-33-feet. A drill stem test of the upper sand completion indicated productivity too low to justify the additional cost of a twin string dual. Production tubing was run with a single packer, a side-door choke landing nipple, and a side-door choke.

The side-door choke was removed after displacing drilling mud, and the multiple completion choke assembly was installed in its place. Testing now is in progress to establish potential of the two zones.

The flowing bottom hole pressure of the lower zone is reduced from 6,500 psi to 1,350 psi across the tool. Surface pressure is regulated at 150 psi and can be increased with an adjustable choke, if necessary, to control upper zone production. Tubing pressure immediately above the multiple completion tool can be elevated to approximately 3,250 psi without changing the lower zone rate.

The necessary wire line operations in this deep, high pressure, high temperature, directional well have been performed with relative ease; however, a word of caution is directed to anyone planning to use this tool for the first time: someone with previous experience should be on the job. Dressing and running the assembly would not be a routine operation to an inexperienced person and could jeopardize success of the installation.

The multiple completion tool can be used in a wide range of wells: dual oil; dual oil and gas; dual gas (the tool is ideally adapted to dual gas wells and is being used in that capacity in Mexico); permanent completions; and gas lift installations.

To determine whether the tool has application in any particular well, one must first determine the pressure that will exist at the point of commingling. This will be the controlled surface pressure plus the pressure required to lift the combined fluids to the surface, the latter being essentially a function of gas-liquid ratio,

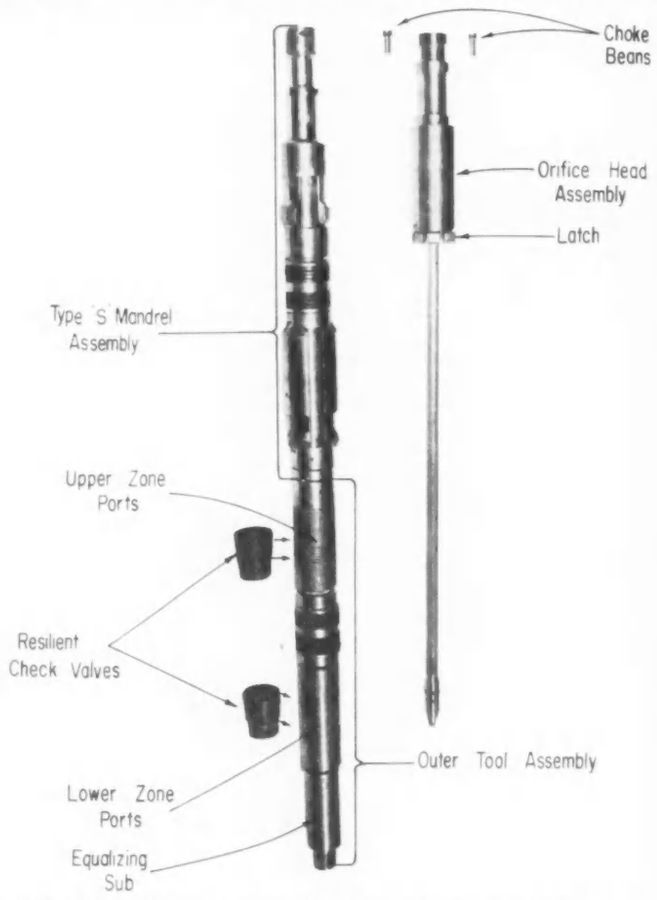

FIGURE 3—Elements of multiple completion tool are shown here. Orifice head assembly can be retrieved separately to blank off one choke for well test purposes or to change production chokes.

TABLE 1—Test Results of Upper Well With Lower Well Blanked Off

TEST DATE	Choke Size	Oil-BPD	Gas-Mcfd	GOR
7-24-60	5/64"	7.23	248	34,200
10- 5-60	5/64"	7.80	227	29,100
10-18-60	5/64"	7.80	227	29,100
12- 4-60	5/64"	7.23	209	28,900
1-27-61	3-5/64"	6.38	175	27,500

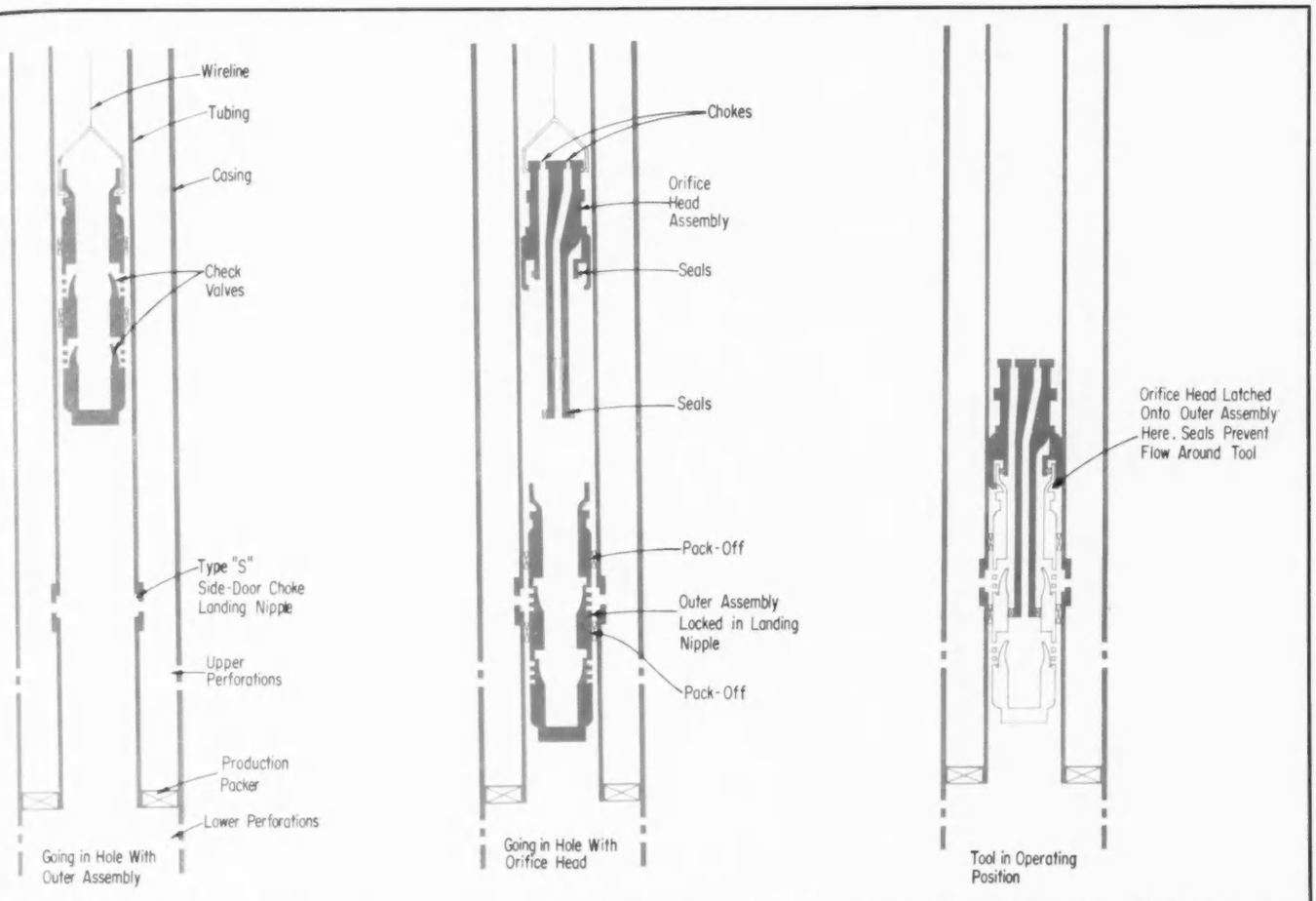

FIGURE 4—Inner and outer assemblies are run separately as shown. Note in center drawing that resilient check valves in outer assembly prevent interzone flow.

production rate and tubing size. Published flowing gradient curves covering almost any set of conditions now are available and can be used for this purpose. Pressure at the point of commingling and productivity index of the weaker well will determine its maximum rate of production.

Use of the multiple completion tool as a gas lift mechanism offers interesting possibilities. When gas direct from the formation is used to lift liquids through the tool, the gas is put to work at maximum depth and pressure thus obtaining maximum efficiency. Single point injection with a retrievable flow valve, considered by many to be the ultimate in gas lift, can be attained with the multiple completion tool.

Field tests of the multiple completion tool have demonstrated it to be a means of increasing current income as well as ultimate recovery at reduced operating costs. This should appeal to all segments of the industry —oil companies, royalty owners and regulatory agencies.

Future development of the multiple completion tool depends to a large extent on acceptance by conservation commissions, as well as the oil industry. Acceptance in turn depends on a thorough understanding of the tool and an appreciation of its potential worth. Some traditional ideas and concepts must be re-examined. There is a great difference between controlled and uncontrolled subsurface commingling. Sun has clearly demonstrated in field tests that wireline tools can be used to separate the production from two reservoirs, to control the rate of production from each and to change the rate of production as required.

The interest and cooperation shown by the Louisiana Department of Conservation has been a material factor in the present stage of development of this new production technique.

About the Author

J. W. Hodges received a B.S. degree in petroleum engineering from The University of Texas in 1938. He joined Sun Oil Company upon graduation and has worked as seismographer, roustabout, roughneck, pumper, drilling engineer, production engineer, field superintendent, division petroleum engineer and administrative engineer, his present position. He holds several patents on oil field tools and has several pending, including one on the multiple completion tool discussed in this article.

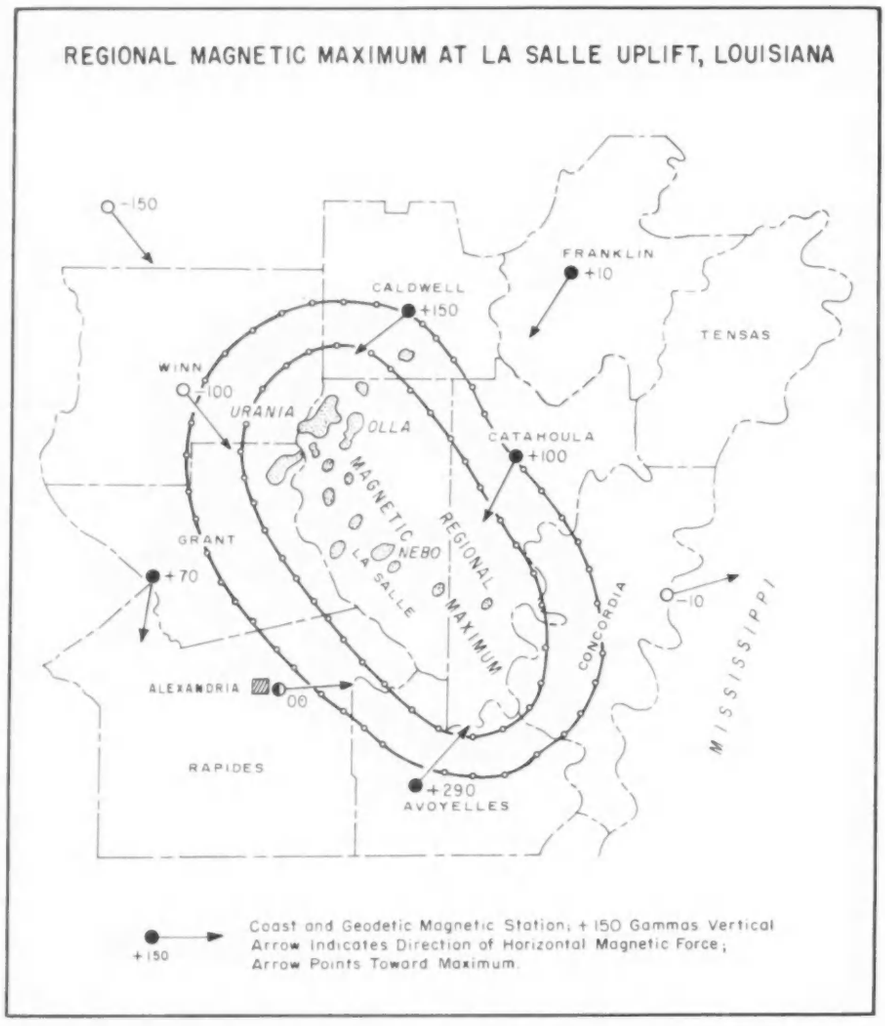

FIGURE 2—Regional magnetic maximum coincides with well known La Salle uplift, dotted with oil fields.

La Salle uplift, Louisiana. Figure 2 shows magnetic vectors[7, 8] as computed from U.S. Coast and Geodetic Survey data in the La Salle uplift area in central Louisiana. A black station point indicates a positive vertical anomaly. Arrows point in the direction of increasing magnetic intensity.

The arrows suggest a large positive magnetic anomaly or basement uplift in the area of known regional structure. This information is now only of academic interest, but in an unknown prospective oil region it would have significant practical meaning, as the numerous oil fields on the La Salle uplift attest.

Venezuela. Regional magnetics are, of course, closely related to regional structures of the basement complex. A less well-known fact is that a minimum of magnetic data sometimes may give a fair geological appraisal of a whole country. The isogon map of Venezuela (Figure 3) is a good example.

Isogons are lines of equal declination. Wherever the actually measured value of the declination differs from an averaged terrestrial value (dashed lines), some anomalous source must influence the compass. Northeast of San Cristobal, the zero isogon swings westward from the averaged terrestrial value. Some positive magnetic anomaly must be present west of the isogon to pull the compass needle west of zero. From the total essentially horizontal intensity of some 30,000 gammas in this region, the magnetic pull there

Part 2

Regional magnetic data show prospective trends

Revealed geologic structure, lineaments indicate likely areas for oil and gas accumulation

By W. P. Jenny, Consulting Geologist and Geophysicist, Houston

THE USEFULNESS OF MAGNETICS for reconnaissance oil and gas exploration is well known, but improvements nevertheless have been made in this phase in recent years to provide even more rapid and effective regional coverage.

Second in series . . . m

This article, showing the utility o magnetic data for regional oil explora tion, is the second of a five-part series o magnetic and micromagnetic interpreta tion. The first article, published in th September 1961 issue of WORLD OI (Pages 90-92) shows how dual-leve aeromagnetic surveying allows precis

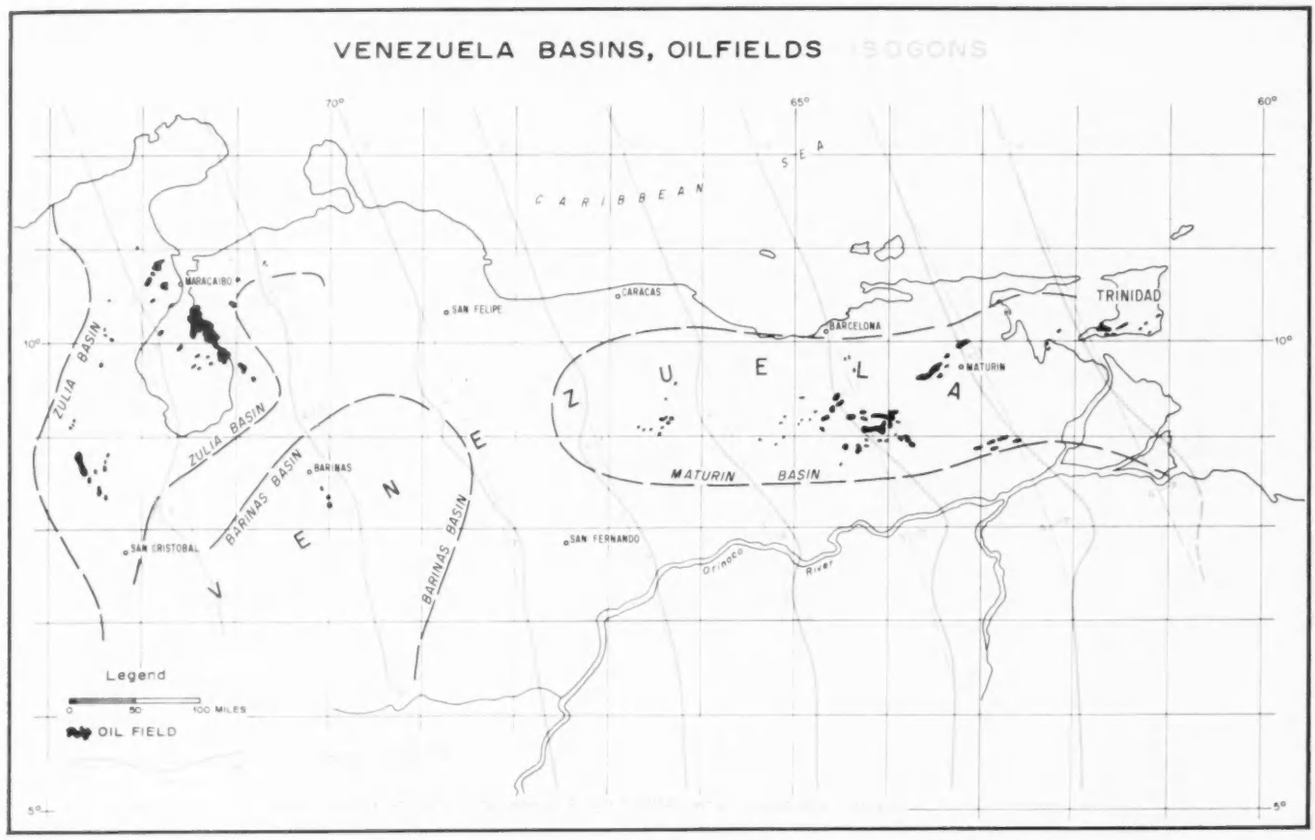

FIGURE 3—Regional isogon map reflects general geologic structure of Venezuela and oil-productive trends.

may be figured at about 2 times 50 or about 100 gammas.

The arrows point towards increasing magnetism eastward along the Orinoco River and westward along the axis of the Maturin Basin.

The isogons would thus indicate an eastward-dipping basement in the Maturin Basin and suggest along its axis a basement anticlinal trend.

Along the Orinoco pre-Cambrian metamorphics are either more magnetic toward the east or a more magnetic basement complex rises in that direction.

The westward swing in isogons along the northwest and north rim of the Barinas Basin is indicative of Paleozoic outcrops in this area. The arrows might even suggest a continuation of this trend through San Fernando.

The eastward swing of the isogon in the western part of Lake Maracaibo suggests an anticlinal trend farther east.

From this isogon study, it appears likely that the main oil fields in the Maracaibo and Maturin basins are located along basement anticlinal trends through the axes of these basins.

In the next part (Number 3) of this series, local magnetics and micromagnetics will be discussed in detailed case histories of oil and gas discoveries on previously-mapped magnetic anomalies.

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(Sequence continued from Part 1 of series)

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8. Jenny, W. P. "Geological interpretation of regional magnetic anomalies in central and southern United States", *The Oil Weekly* 103, No. 3, 17-22 (September 22, 1941).

About the Author

Dr. William Paul Jenny is a consulting geologist and geophysicist in Houston. He received his academic training in Switzerland at the University of Geneva and at the University of Zurich, where he received his doctorate in geology. Jenny came to the United States in 1925 as a geophysicist for Shell Oil Company and was later in charge of geophysics for Magnolia Petroleum Co. (now Mobil Oil Co.) in Dallas. He has been a consultant since 1932.

...more to follow

micromagnetic interpretation of aerial coverage. The third article, to follow next month, reviews case histories of micromagnetic prospects, some of them published previously in WORLD OIL or its predecessor *The Oil Weekly* with drilling development updated to the latter part of 1960.

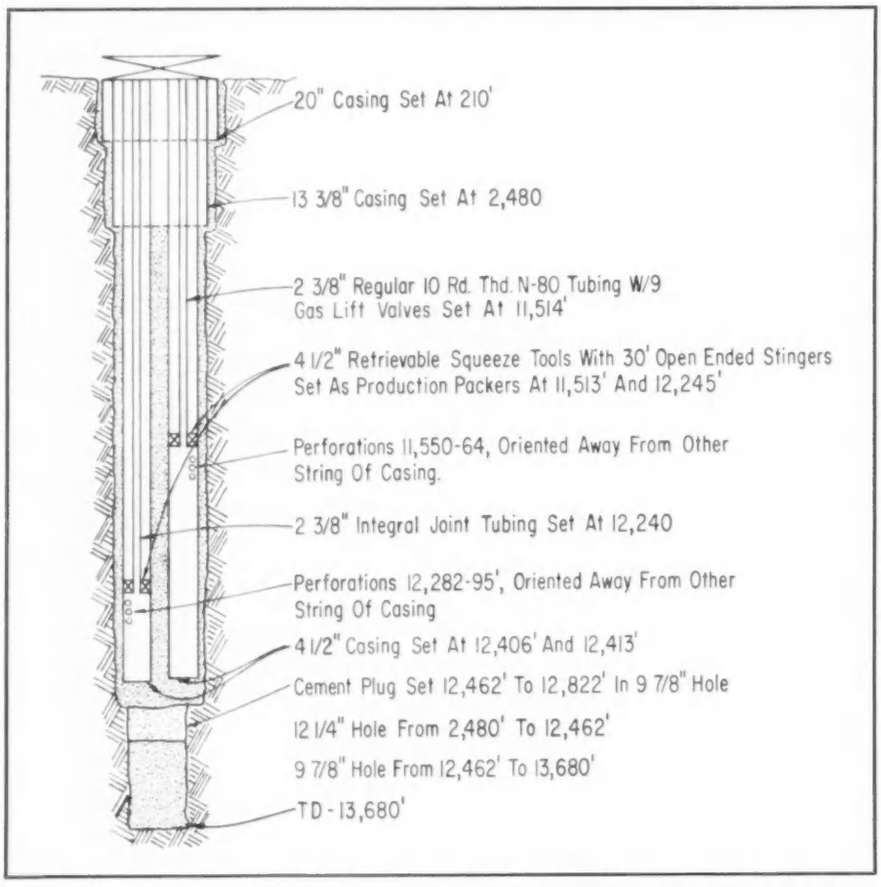

20" Casing Set At 210'
13 3/8" Casing Set At 2,480
2 3/8" Regular 10 Rd. Thd. N-80 Tubing W/9 Gas Lift Valves Set At 11,514'
4 1/2" Retrievable Squeeze Tools With 30' Open Ended Stingers Set As Production Packers At 11,513' And 12,245'
Perforations 11,550-64, Oriented Away From Other String Of Casing.
2 3/8" Integral Joint Tubing Set At 12,240
Perforations 12,282-95', Oriented Away From Other String Of Casing
4 1/2" Casing Set At 12,406' And 12,413'
Cement Plug Set 12,462' To 12,822' In 9 7/8" Hole
12 1/4" Hole From 2,480' To 12,462'
9 7/8" Hole From 12,462' To 13,680'
TD - 13,680'

FIGURE 1—Southern Natural Gas Company's 12,400-foot Zenor 14 well, Patterson Field, St. Mary Parish, Louisiana, is equipped with twin parallel strings of 4½-inch OD casing. Schematic diagram shows details of completed well.

In deep, multiple wells . .

New completion will cut workover costs

Southern Natural Gas Company's unique twin casing string well eliminates communication between zones caused by packer failures, blast holes in tubing.

By Robert H. Adolph, Petroleum Engineer, and
Joe B. Cobb, General Drilling Superintendent,
Southern Natural Gas Co., Houston

SOUTHERN NATURAL GAS COMPANY has completed the industry's first deep dual well equipped with twin parallel strings of 4½-inch OD casing.

The twin strings were run simultaneously and set in a single borehole at a depth of 12,400 feet in Southern Natural's Zenor 14 well, Patterson field, St. Mary Parish, Louisiana.

The parallel string method was used to complete the well in an effort to solve field production and workover problems associated with conventional dual wells equipped with tubing strings set through upper producing intervals. Figure 1 shows a schematic drawing of the new installation.

Advantages of the parallel completion method, especially in the South Louisiana area, are as follows:

- Prevents communication between zones resulting from blast holes in tubing strings set through upper producing intervals, or packer failures.

- Provides positive segregation of producing intervals. Each string can be worked over individually without simultaneously exposing both productive zones to workover fluids.

- Reduces workover costs since work on one zone is equivalent to a single well workover. Also, one string can be reworked while the other remains on production.

- Eliminates difficulties encountered in pulling dual parallel tubing strings, which are frequently intertwined. Costly fishing jobs have resulted because of pipe entanglement and collar interference.

- Permits use of externally mounted gas lift valves in each string and eliminates possibility of interference between valves while lifting.

Purpose. Chief reason for running twin strings of 4½-inch OD casing in a single borehole was to reduce frequency of workovers and workover costs when they are required. In most cases, workovers of conventional parallel string multiple completions in South Louisiana are caused by communication between producing zones which result from blast holes in tubing set through upper zones of production, or from packer failure. When workovers are required to correct such difficulties, additional problems arise which increase costs or damage well productivity.

For example, entangled parallel tubing strings are difficult to pull and often result in expensive fishing jobs. Also, productive intervals are often damaged by workover fluids especially if high differential pressures exist between zones.

As mentioned previously, the twin string procedure eliminates most of these problems and has many other advantages over conventional parallel tubing string completions.

Planning. Major items initially considered were casing string design and hole size necessary to insure running both strings to TD. Contact was made with other companies concerning their programs for small diameter well completions. After discussion and comparison of the various standards used, a decision was made to drill a 12¼-inch hole to 12,400 feet and then simultaneously run two strings of 4½-inch OD casing to total depth. Actual casing design is given in Table 1.

Casing OD is 4.500 inches, and collar OD 5.000 inches. Even if collars on both casing strings fell together, 2¼-inches clearance remained between pipe and hole. This was felt to be sufficient clearance to run pipe to TD. All collars were beveled on top and bottom to prevent collar engagement.

The design used for each string of casing had a safety factor for tension at the top joint of 1.686, based on pipe weight in air. This is lower than the standard 1.80 used by Southern Natural and most companies, but still is considered good engineering practice.

Casing of necessary grade and weight was not readily available and had to be ordered from the mill. Some drill pipe of equivalent size was found, but was not used since inside diameter would not allow use of externally mounted gas lift valves on inner tubing strings.

Upon inspection at the mill, about 20 percent of the pipe was rejected as not meeting API standards. Such inspection is considered especially important for small diameter pipe, because of its thin wall thickness.

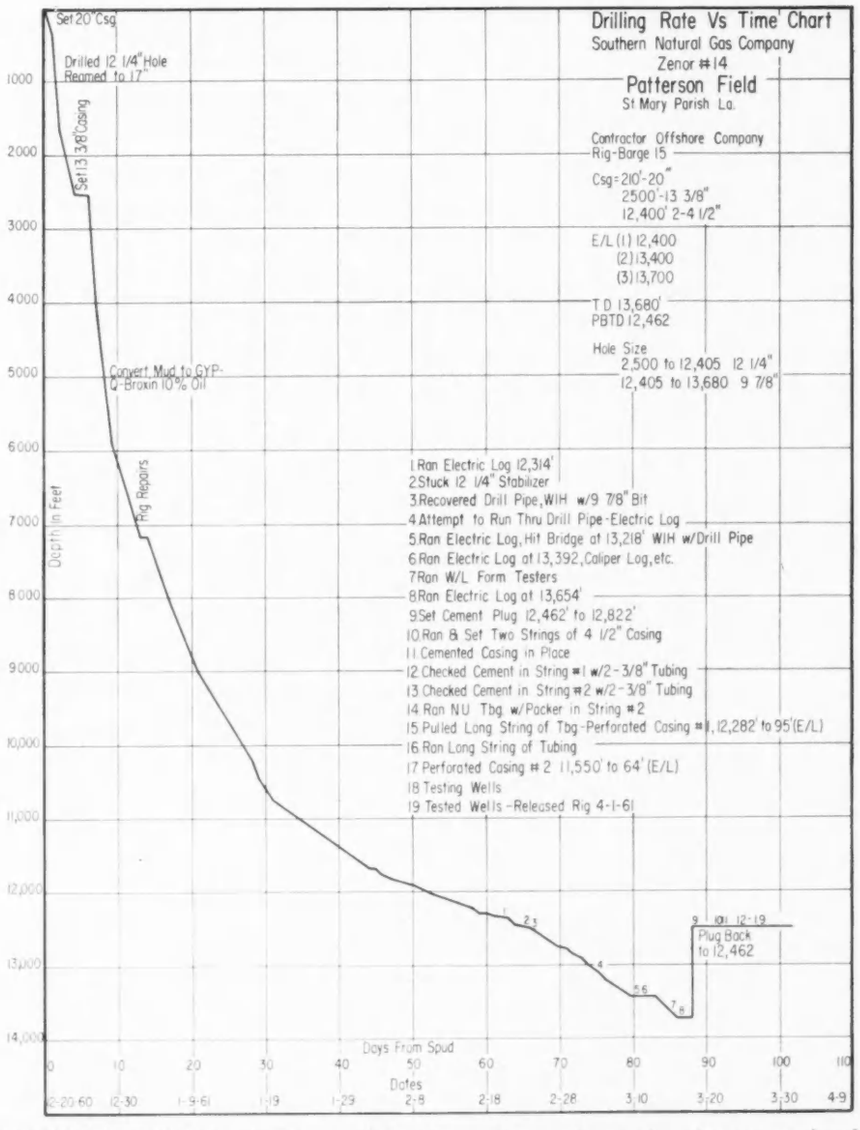

Drilling Rate Vs Time Chart
Southern Natural Gas Company
Zenor #14
Patterson Field
St Mary Parish La.
Contractor Offshore Company
Rig-Barge 15
Csg=210'-20"
2500'-13 3/8"
12,400' 2-4 1/2"
E/L (1) 12,400
(2) 13,400
(3) 13,700
T.D. 13,680'
PBTD 12,462
Hole Size
2,500 to 12,405 12 1/4"
12,405 to 13,680 9 7/8"
Set 20" Csg
Drilled 12 1/4" Hole Reamed to 17"
Set 13 3/8" Casing
Convert Mud to GYP-Q-Broxin 10% Oil
Rig Repairs
Depth in Feet
1 Ran Electric Log 12,314'
2 Stuck 12 1/4" Stabilizer
3 Recovered Drill Pipe, WIH w/9 7/8" Bit
4 Attempt to Run Thru Drill Pipe-Electric Log
5 Ran Electric Log, Hit Bridge at 13,218' WIH w/Drill Pipe
6 Ran Electric Log at 13,392, Caliper Log, etc.
7 Ran W/L Form Testers
8 Ran Electric Log at 13,654'
9 Set Cement Plug 12,462' to 12,822'
10 Ran & Set Two Strings of 4 1/2" Casing
11 Cemented Casing in Place
12 Checked Cement in String #1 w/2-3/8" Tubing
13 Checked Cement in String #2 w/2-3/8" Tubing
14 Ran N.U. Tbg. w/Packer in String #2
15 Pulled Long String of Tbg-Perforated Casing #1, 12,282' to 95' (E/L)
16 Ran Long String of Tubing
17 Perforated Casing #2 11,550' to 64' (E/L)
18 Testing Wells
19 Tested Wells-Released Rig 4-1-61
9 10 11 12-19
Plug Back to 12,462
Days From Spud
Dates
12-20-60
12-30
1-9-61
1-19
1-29
2-8
2-18
2-28
3-10
3-20
3-30
4-9

FIGURE 2—Drilling rate for parallel string well was slower than for conventional completions in the area because of maximum allowable hole deviation of one degree. Drilling chart summarizes complete job.

TABLE 1—4½-inch Casing String Design

Depth	Wt. & Grade	Interval	Weight/ Interval	Cum. Wt.	Collapse	Press.	C.F.
12,400	13.5 N LT&C	2,600	35.1	0	7,350	6,200	1.185
9,800	11.6 N LT&C	7,500	87.0	35.1	5,700	4,900	1.163
2,300	13.5 N LT&C	2,300	31.	122.1	4,200	1.150	3.652
0				153.1	.....	....	....

Depth	Wt. & Grade	Interval	Weight/ Interval	Cum. Wt.	Ten. Sx.	T.F.	Corr. For Buoyancy 12.5# Mud
12,400	13.5 N LT&C	2,600	35.1	0	285	....	...
9,800	11.6 N LT&C	7,500	87.0	35.1	220	6.26	7.73
2,300	13.5 N LT&C	2,300	31.	122.1	220	1.802	2.22
0				153.1	258	1.686	2.08

Mill inspection proved advantageous because of the high percentage of rejects. Thus, freight costs for replacement of bad order pipe and time necessary to transport replacement pipe from mill to location were reduced considerably.

An original plan to run both strings with a common special guide shoe and banded together with steel banding, was abandoned for fear of one string becoming stuck while running in the hole. Strings were run with conventional float shoes and unbanded so that if one became stuck, two alternatives remained:

1. If pipe became stuck at a depth above a producing zone, the free

string could be pulled from the hole, and the stuck pipe fished using conventional methods.

2. If pipe became stuck after passing a proposed completion zone, the free string could be run to bottom and used to complete the lower zone.

Meetings were held with representatives of various supply and service companies to determine availability of materials needed, feasibility of running strings simultaneously and methods for completing the well once pipe was in place. Points covered were:

1. Special tools needed for simultaneous running
2. Blowout preventers
3. Christmas tree design
4. Cementing methods
5. Perforating methods.

As soon as air operated slips, elevators and special wellhead equipment had been designed and built, the group which was to run the casing (including the contractor's superintendent) met at the manufacturer's plant for a trial run. Many small points of procedure were worked out, and necessary modifications made. This procedure contributed significantly to the later success of the job.

Drilling. The chart shown in Figure 2 outlines the program followed in drilling and completing the well. Drilling time was increased over that normally required to drill to comparable depths in the field primarily because hole deviation was restricted to a maximum of one degree.

Running casing. Rig pipe rack space was limited since the operation was conducted on a marine location from an inland drilling barge. Initially, only 13.5 pound casing was racked on the rig proper. The remaining 15,000 feet of 11.6 pound pipe was unloaded on the rig after drill pipe was laid down and loaded out, and while initial casing was being run. No time was lost due to this procedure.

Initially, a split bowl and hand-operated slips were used to support

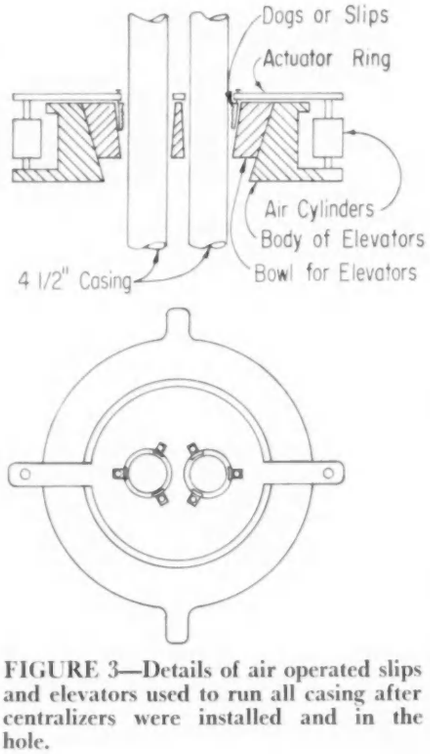
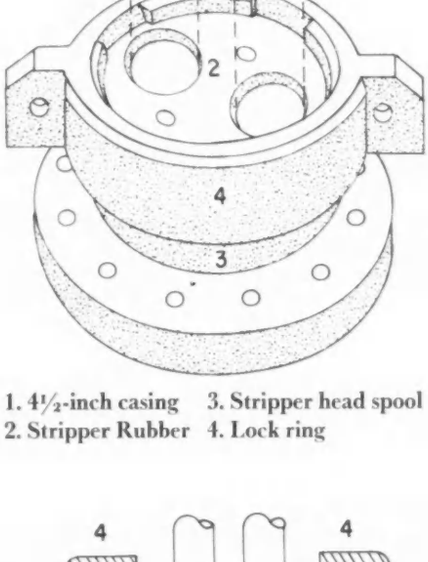


FIGURE 3—Details of air operated slips and elevators used to run all casing after centralizers were installed and in the hole.



1. 4½-inch casing 3. Stripper head spool
2. Stripper Rubber 4. Lock ring

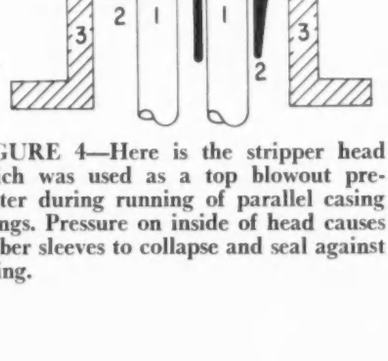


FIGURE 4—Here is the stripper head which was used as a top blowout preventer during running of parallel casing strings. Pressure on inside of head causes rubber sleeves to collapse and seal against casing.

the twin casing strings. This arrangement was required so that the double casing hanger (which would not pass centralizers) could be stripped over the casing strings after centralized pipe had been run in the hole. Had air operated slips been used at this point, it would have been more difficult to install the hanger.

Modified air operated elevators, similar to those used to run multiple tubing strings, were used throughout the operation. Elevators were suspended from the block by 10-foot bails to accomodate cementing heads.

Once centralizers were run, air operated slips were installed. Figure 3 shows details of this equipment.

Hydraulic tongs were used to make up casing. Tongs were suspended opposite the stabbing board approximately 30 feet above the rig floor, and each string was made up from this point. A joint of casing was stabbed on the rig floor and the power tongs then engaged from the stabbing board to make up each joint. After the No. 1 string casing joint was made up, it was pulled to one side to allow room to make up a joint in the No. 2 casing string. Because of the flexibility of 4½-inch casing, no problems were encountered in this operation.

Prior to running pipe the bag type preventer was removed and replaced with a high pressure stripper head. This procedure was necessary for well protection since the bag type BOP would not close effectively around twin strings of casing.

Although the stripper head could have been installed on top of the bag type preventer, this would have left little clearance between the preventer hook-up and the rotary. Since the manual slip-split bowl arrangement also would not pass centralizers, this equipment had to be installed beneath the derrick floor between the rotary and BOP hook-up. Thus, the bag type preventer-stripper head combination simply resulted in an over-all BOP hook-up which was too tall.

Only the stripper head spool was installed initially, since centralizers could not be run through the rubber pack-off element. Figure 4 shows details of the stripper head.

Ram type BOP's were left in place during the complete operation, but

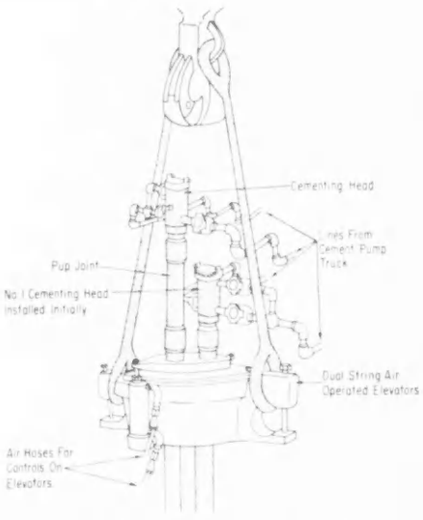

Cementing Head
Lines From Cement Pump Truck
Pup Joint
No. 1 Cementing Head Installed Initially
Dual String Air Operated Elevators
Air Hoses For Controls On Elevators

FIGURE 5—Dual cementing head hookup for twin string well. Pup joint was used as spacer in string at left to provide working room.

choke lines were replaced with a 4-inch flow line.

Each casing string was equipped with a float shoe on bottom. Float collars were installed 60-feet off bottom. Centralizers were installed alternately on each string, beginning 4 feet above the float collar on one string and 4 feet below on the other string. Thereafter, centralizers were run on every other joint of each string. A total of 65 centralizers were used.

After centralizers were run and the casing hanger installed, the stripper rubber section was lowered into position in the stripper spool and locked in place. Automatic air slips were installed and remaining casing was run. Total time required to run both strings of casing (24,800 feet) was 21 hours and 15 minutes. Casing running was performed without incident. The first 2,000 feet was run slowly since centralizers were being installed below the floor. After installation of centralizers, joints were made up and run in less than 1½ minutes per pair.

All casing was tallied and numbered when loaded-out. This master tally was used to keep track of the pipe as it was being run. Two men (one per casing string) were responsible for getting the number and length of each pair of casing joints as they were run. These tallies then were checked against the master tally to determine amount of pipe run and final setting depth.

Cementing. After reaching bottom, a cementing head was installed on the "higher" casing string which then was circulated. A 6-foot pup joint was made up in the "lower" string to provide clearance for installation of the second cementing head. Figure 5 shows the final installation.

The surface cementing hookup is shown in Figure 6. Four pumps (2 per cementing unit) were used on each string of casing and slurry was displaced simultaneously in each. The hookup shown was used in an effort to obtain turbulent flow characteristics in the annulus during displacement.

About the Authors

R. H. Adolph J. B. Cobb

Robert H. Adolph is a Petroleum Engineer for Southern Natural Gas Company. He received a BS degree in petroleum engineering from Louisiana State University in 1950. He worked as a field engineer for Schlumberger Well Surveying Corporation in South Louisiana, and for two years was an instructor in the petroleum branch of the U.S. Army Quartermasters Corps. Adolph has been employed by Southern Natural for the past six years working on various assignments in the Reservoir, Production, and Drilling departments.

Joe B. Cobb is Southern Natural Gas Company's general drilling superintendent. After graduation from Louisiana State University in 1938 with a BS degree in petroleum engineering, he worked as district engineer for the Louisiana Department of Conservation. After four and one-half years in the Navy (1941-1945) he was with Sohio Petroleum Company for 15 years, as field engineer, district engineer, district superintendent and assistant to the division production manager. He joined Southern Natural Gas Company in March 1960. He is a member of API, and has served as Southern District chairman of the Committee on Supervisory Development for the past three years.

The job consisted of the following (for each casing string):

1. 500 gallons non-acid mud thinner
2. 780 sacks pozmix "A" 50:50 common cement plus 18 pounds salt per sack plus 4/10 percent retarder
3. 188 barrels mud for displacement.

Because of high pump speeds required to attain turbulent flow in the annulus, mud for displaceing was obtained from gaged tanks to prevent over-pumping plugs. These volumes were in turn checked with flow meters. The initial 170 barrels were pumped at a maximum rate and the final 18 barrels at a slower rate. Also, rates were adjusted by flow meter readings so that plugs bumped concurrently. The complete displacing operation is summarized in Table 2.

Because of wellhead restrictions, it was only possible to achieve about 75 percent of the pumping rate calculated for turbulent flow. However, the cement job was successful and no block squeezes were required. Wellhead modifications now have been made to overcome this difficulty.

Because of the critical tension design factor, pipe was not reciprocated during the cementing operation. However, this procedure will be considered on future installations.

Completion. After nippling up, 2⅜-inch OD tubing was run in each

TABLE 2—Details of Cementing Operation

Time	Operation
0- 3 Min.	Two pumps, 1 per string, placing 1000 gal. of mud flush, 500 gals/string.
3-38 Min.	Mixing 1000 cu. ft. of slurry, 14.9#/gal, and placing in each string.
38-42 Min.	Flushing cement lines to rig floor and releasing top plug and following plug with 4 bbls. of water.
42-46 Min.	Pumping with two pumps/string, pump pressure 750 psi, pumping rate 8.75 bbls/min.
46-54 Min.	Pumping with three pumps/string, pump pressure 1250 psi, pumping rate 13.1 bbls/min.
54-57 Min.	Pumping with two pumps/string, pump pressure 1000 psi, pumping rate 8.25 bbls/min.
57-58 Min.	Reduced pumping rate for landing plug-pumping with one pump/string. Pump pressure 700 psi, pumping rate 3.5 bbls/min.
58 Min.	Plug hit bottom.

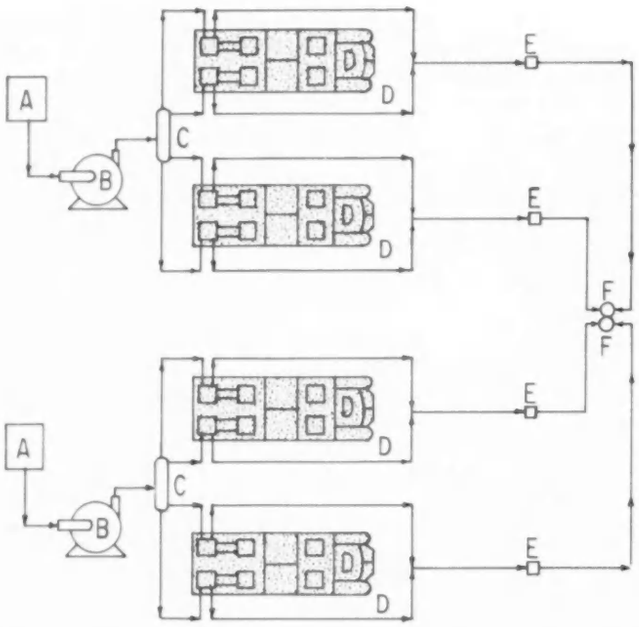


FIGURE 6—Cementing equipment layout shows (A) mud tank gaged for volume of mud required to displace cement from casing, (B) centrifugal pumps used to supply mud to pump trucks, (C) manifold system, (D) pump trucks, (E) flow meters and (F) twin casing strings.

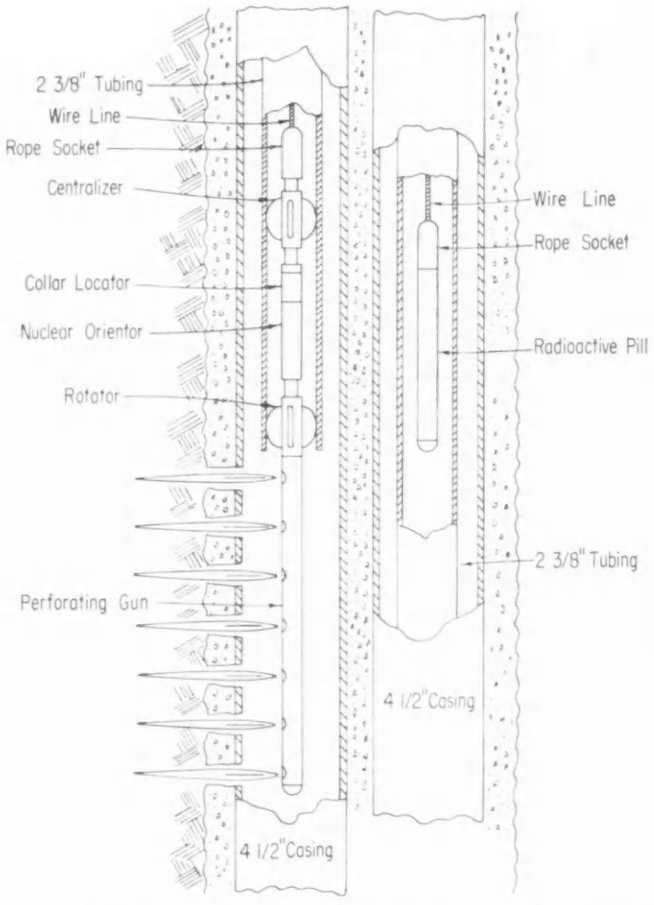


FIGURE 7—Upper zone of well was perforated in unique manner with oriented through-tubing gun. As shown, upper portion of perforating assembly remained in tubing while charges were fired in the casing below.

string to check cement tops and to circulate the wells. Because of low bottom hole pressure and permeability, it was decided to perforate the upper interval (11,550-564) in water to prevent mud damage to the formation. Thus, the No. 2 casing string was completely displaced with water.

After conditioning and logging, the lower interval (12,282-295) was perforated directionally by casing gun with mud in the hole. Since quality of the primary cement job was unknown, it was decided to perforate the upper zone by the through-tubing method. Some well control difficulties could have been experienced had a casing gun been used since only water was in the hole and there was a possibility of communication between the low pressure zone of interest and other high pressure intervals.

After perforating the lower zone, tubing equipped with a full open retrievable squeeze tool was run and set in each string. Gas lift valves were installed in the upper zone No. 2 string.

The retrievable full open squeeze tools were run as packers since there was doubt as to the effectiveness of the primary cement job. Had a squeeze been required, tools would have been in position and considerable time would have been saved. However, no squeeze jobs were needed in either string and tools were simply left as production packers.

Perforation of the upper zone was unique in that the centralizer, nuclear orienter and rotator portion of the perforating device remained inside the tubing string while charges were fired in the casing string below (Figure 7). This was the first use of oriented equipment for such an operation. The setting of the short tubing string was checked by gamma ray log to correlate its bottom with the zone to be perforated. Obviously, precise perforation depth control was required.

It was necessary to keep the centralizer and rotator for the orienting device inside the tubing string since operation of these elements depend upon friction drag between springs and wall of the pipe for proper operation. The perforating gun was positioned below the tubing to obtain maximum penetration of the casing and to prevent possible splitting of the tubing string.

Both zones were perforated in directions less than 180° from adjacent casing to prevent blast holes from developing between strings. It is unknown whether this practice is necessary in 4½-inch casing, but there have been instances where both sides of 2⅜-inch tubing have been penetrated by the jetting action of an upper zone. It is felt that this jetting action may be of sufficient force to result in communication after a period of time. For this reason, holes were deliberately angled away from adjacent strings of casing so that any resulting blast hole would not direct jets of produced fluid toward the second string.

After perforating, both wells were cleaned in a normal manner and turned into the stock tanks for production. **—The End**

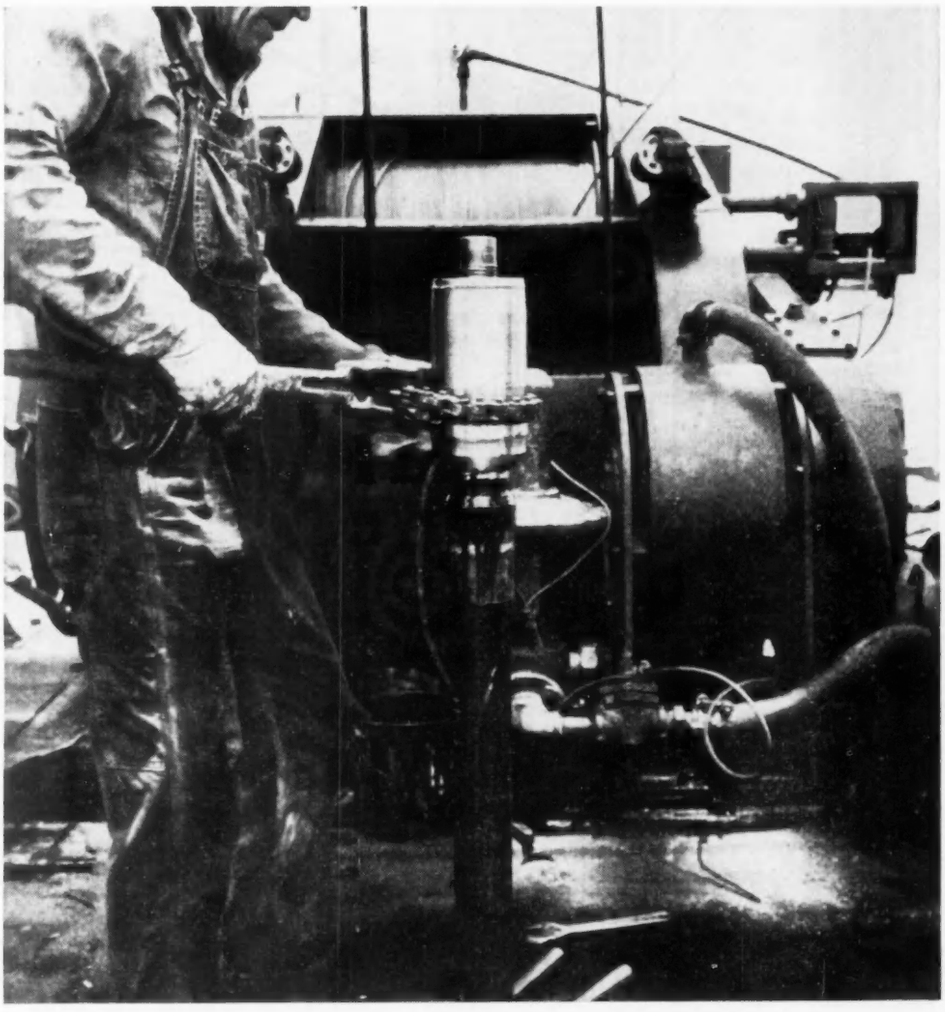


FIGURE 25—Installation of individual hanger on a bull plugged casing string run by the individual method. Back-pressure valve has been installed in hanger so string can be pressured once it is set in master hanger.

Part 3: Casing Running and Cementing Practices

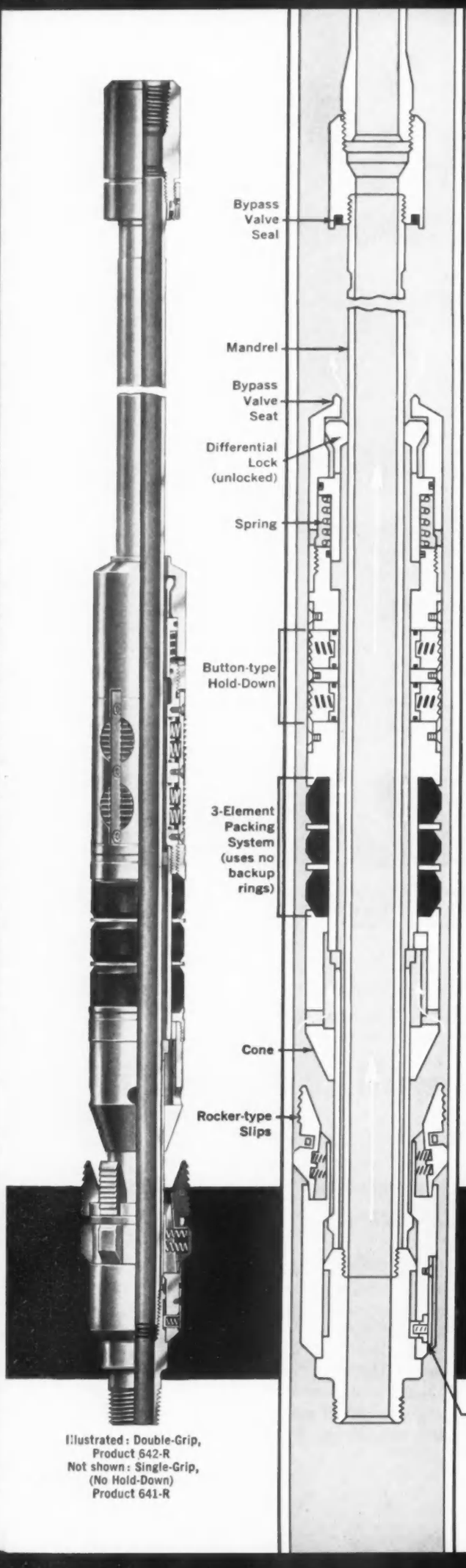
Small diameter well completions

By R. W. Scott,
Engineering Editor, WORLD OIL

THIS PHASE of small diameter well completions has presented operators with serious challenges. No particular difficulties have been encountered with single string completions. But many producers now think multiple string installations are not economically or mechanically feasible due to the poor primary cementing results generally experienced. For example, one operator has recorded almost 100 percent failure in attempts to cement multiple string wells.

Much attention has been given this subject. Present day techniques have been improved over early efforts and several companies have minimized the problem to a great degree.

During initial small diameter well work in areas where cementing had proved a problem, one company had a primary cement job success ratio—based on completion intervals—of about 30 percent on triple string installations. Dual and quadruple string wells were 65 percent successful. However, modification of mud programs, casing running and cementing techniques and primary cementing equipment has increased success ratios to duals—92 percent; triples—84 percent; and quadruples



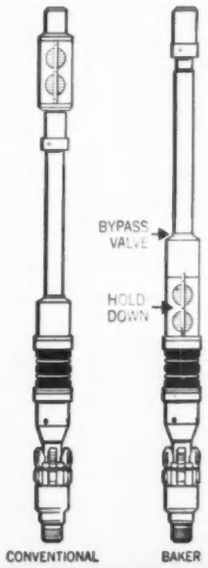
Illustrated: Double-Grip, Product 642-R
Not shown: Single-Grip, (No Hold-Down) Product 641-R

A new concept in retrievable casing packers

BAKER MODEL "R"

DOUBLE-GRIP RETRIEVABLE CASING PACKER

- **An advanced new long-stroke (30″) packer... with simple one-turn-right control-pin setting, automatic bottom and integral hold-down.**
- **Designed for combination acidizing, fracturing and production operations.**



LOCATION OF THE HOLD-DOWN IS FUNDAMENTAL TO THE NEW CONCEPT

In most conventional long-stroke packers, the hold-down is attached in afterthought-fashion to the mandrel, above the bypass valve. Hold-down buttons are directly exposed to button-dulling pressure surges in the tubing and to particle-bearing fluids that may deposit solids behind them. The bypass valve cannot be used to equalize pressures.

In the Baker Model "R" Packer, the hold-down is an integral part of the packer, below the bypass valve. This new concept restores surface control of the bypass valve for pressure equalization.

PERFORMANCE-PROVED FEATURES

The new design concept alone would doubtless make the Model "R" a superior packer. But it offers much more. For into it Baker has built components of the type proved on their high-performance service tools... features like those shown at right, and never before available in long-stroke packers.

Today's practice of fracturing and acidizing in combination with production—both initially and later—requires a new type of packer. It must dependably hold pressures from below and at the same time perform as an efficient production packer. It must be simply run and easily retrieved by the operator.

Afterthought Hold-Downs Not the Answer

Conventional long-stroke packers with a hold-down added to the mandrel as an extra cannot fully meet this need—they were never really designed for this kind of use.

The added hold-down created problems, and often did not hold dependably. Operators found that hold-down buttons would dull on the way in. The packer often proved difficult to release as there was no simple way to equalize pressure across the hold-down, and sand or frac materials tended to keep the buttons from retracting.

A New Concept Was Needed

In designing the Model "R" Packer to meet the operator's needs, Baker came up with a whole new concept. As explained below, button dulling has been minimized because the ample bypass area is completely isolated from pressure surges in the tubing. Pressure differentials across the hold-down and the packer can be instantly equalized by simply picking up on the tubing. The mandrel can be used as a jar at any time, as it is not held inoperative by the hold-down.

To the many advantages brought about by a new design approach, Baker added high-quality, performance-proved components never before found on long-stroke packers.

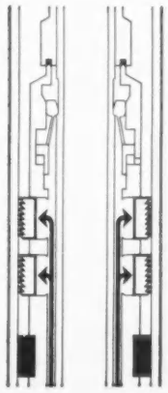
Baker Stands Behind Every Packer

Back of the Model "R" is the Baker Service Organization. Domestically, 62 Baker field-service warehouses stand ready to supply packers, parts and repair service. Over 400 Baker servicemen are available to help you in planning applications for this packer. Why not ask one of them to tell you more about the great new Model "R" Packer.

BAKER

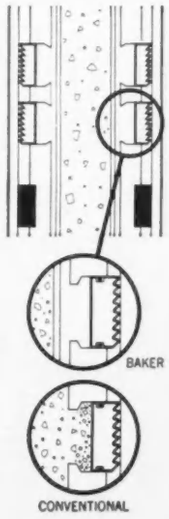
BAKER OIL TOOLS, INC.

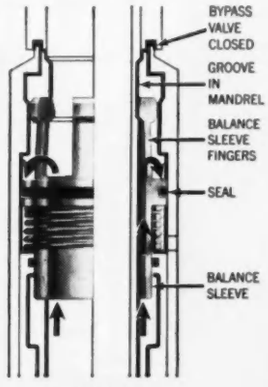
HOUSTON/LOS ANGELES/NEW YORK



HOLD-DOWN IS ACTUATED BY PRESSURES FROM BELOW PACKER. The hold-down buttons are isolated from pressure surges in the tubing. Surface bleed-off is never required, as the bypass valve can be opened at anytime. Pressure differentials can be instantly equalized, even if the tubing is plugged.

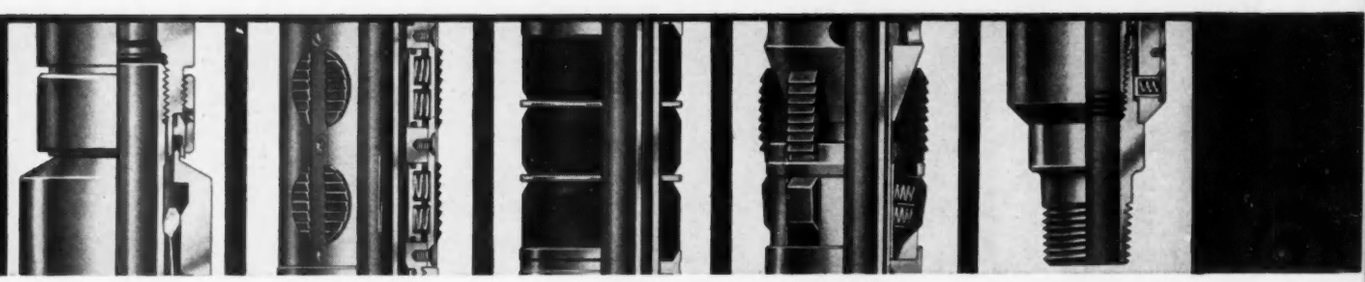
BUTTONS ARE ISOLATED FROM CONTAMINATED FLUIDS. Sand and other solids cannot build up in back of the buttons and thus interfere with button retraction.





UNIQUE DIFFERENTIAL LOCK HOLDS BYPASS VALVE CLOSED. Shown at left, in relation to the packer body, is the Balance Sleeve which forms an important part of the Differential Lock. Note how pressure differentials from below the packer act on this sleeve to force it down so that the fingers of the sleeve wedge into the groove in the mandrel. The very pressure that acts to pump the valve open thus acts to keep it closed—eliminating the need for high tubing set-down weights.

UPWARD MOVEMENT OF TUBING RELEASES LOCK. No rotation or pressure equalization is required.



NEW FACE-SEAL BYPASS VALVE
Instant acting—seals on contact, opens with ¼" pickup. Overcomes plugging and sticking.

PRECISION HOLD-DOWN BUTTONS
Precision fitted to minimize sticking and fouling. Tapered upper surface of teeth aids retraction.

THREE-ELEMENT PACKING SYSTEM
Proven Baker design. Holds under extreme conditions, releases readily. Uses no metallic back-up rings.

DEPENDABLE ROCKER-TYPE SLIPS
Simple, compact, trouble-free. Won't wedge or stick. Performance proved on Baker service tools.

NEW AUTOMATIC BOTTOM
Automatically locks slips in retracted position when tubing is raised the full stroke of the mandrel.

—96 percent. Single string wells have been almost 100 percent successful. Recently the company was experiencing a primary cement job success ratio of about 93 percent in over-all operations. These results are considered comparable with conventional casing job success ratios on an area and interval basis.

It is evident that primary cement job failures can at least be minimized in small diameter wells.

PROBLEMS

The following specific difficulties, any of which can adversely affect the economic advantage of the small diameter completion technique, have influenced present practices:

Channeling of cement. Caused by inefficient annular displacement of mud by cement. Contributing causes are:

1. Poor downhole mud properties (high viscosity, gel strength, solids contents, etc.).
2. Relatively slow annular displacement rates below turbulent flow range. Hole size is usually large in comparison to pipe size, and friction loss is high in small ID casing.

Sticking of first strings run in the hole. Due to inadequate conditioning of hole and working of pipe after initial strings are run. During running of casing, use of full open guide shoes does not permit displacement of fluid from the hole as does float equipped strings. If proper conditioning procedures are not followed, initial strings may become stuck and cannot be reciprocated during cementing.

Lost returns while cementing. An area problem. Influenced by:

1. High annular columns of cement often used in small diameter completions result in increased hydrostatic head on lower formations.
2. Slurry weight.

Cement fill-up on top of follower plug causing drill out of cement in casing prior to completion. Due to:

1. Cement bypassing follower plug during and after displacement.
2. Insufficient washing of cement discharge lines prior to plug displacement. A small accumulation of cement on top of the plug results in high fill-up in small ID casing.

Buckling of casing above cement top. Results from thermal expansion of pipe.

Crooked or kinked casing strings. Caused by landing techniques, thermal expansion, squeezing.

CURRENT PRACTICES

No unusual problems have been encountered in casing and cementing single string small diameter wells. Of course most operators have found that the usual cautions applied to conventional jobs still are a necessity. Liberal use of centralizers and scratchers is common practice, but actual cementing techniques have sometimes been modified.

For example, changes have been made in types of cement used; lead fluids are often pumped ahead of slurry; and pipe movement practices have been eliminated when the cementing operation is performed through the Christmas tree.

Over-all, there is little difference in the physical running of single string small diameter wells and conventional cased completions. However, many changes have occurred when multiple casing strings are involved.

Because of this, the following discussion will deal chiefly with multiple installations. In many cases, casing running and cementing modifications made for multiple wells can be and are applied to single string installations.

Present practices are chiefly the result of efforts to minimize primary cementing difficulties. As might be expected, the problem has been approached from almost every conceivable angle. For example:

1. Casing strings have been rotated and/or reciprocated in both single and multiple completions to aid in filter cake removal.

2. Low viscosity water washes, chemical washes, etc. have been used ahead of the cement in attempts to obtain turbulent flow conditions in the annulus, and to chemically remove filter cake. Abrasive materials have been included in both the wash solutions and the slurry to physically abrade filter cake.

3. On multiple installations, individual strings have been reciprocated; all strings have been reciprocated simultaneously; the first two techniques have been combined (reciprocate one string at a time, all string simultaneously) to break gels between strings and to aid in filter cake removal.

4. The well has been displaced with water prior to running casing so only a low viscosity solution will have to be displaced by slurry.

5. High circulation and pumping rates have been used to increase displacement efficiency.

6. Cement has been displaced through from one to all strings of a multiple string well.

Undoubtedly, some operators have attempted other techniques. Although these procedures have aided, experience has shown control of mud properties to be one of the most important factors involved in improving displacement efficiency.

MUD

Carefully controlled mud properties and clean hole conditions prior to cementing have been found to be prime requisites for efficient displacement of slurry into the casing annulus. If these two factors are ignored, chances are considerably increased for a poor cement job.

Desirable properties have been found to be:

1. Minimum solids content

2. Low gel strength

3. Low yield point

4. Low plastic viscosity

Considerable cementing difficulties have been experienced in South Texas-Gulf Coast operations. Although various types of muds are used in the area, several operators have found gyp mud systems to be an aid in obtaining good cement jobs on multiple string wells without being overly expensive.

Desirable properties for gyp mud systems in this area are as follows:

1. pH—low

2. Gel strength—0

LARKIN SCRATCHERS

Combine all the features proved best for effective scratcher performance.

LARKIN CENTRALIZERS

Long Lok-on Fig. 905 | Short Lok-on Fig. 904 | LARKIN ...Through Your Supply Store | Short Slip-on Fig. 902 | Long Slip-on Fig. 903

Larkin Centralizers exceed all known requirements for centralizer performance. Their time-proved design combines the highest centering force with the lowest permanent set obtainable in a non-rigid centralizer.

Larkin Centralizers are furnished in four different types and each type is available in five different ranges. There is a Larkin Centralizer for every well condition and casing/hole size combination.

Larkin Centralizers need not be under compression to exert the required centering force. High centering strength at initial deflection allows use of Larkin Centralizers with the bows slightly under hole size. This results in easier starting and easier running with greatly lessened scraping of the well bore.

Larkin Scratchers and Centralizers are available . . . "Through Your Supply Store."

LARKIN PACKER COMPANY

Division Koehring Company

WAXAHACHIE, TEXAS

LARKIN LEADERSHIP HAS BEEN EARNED BY YEARS OF DEPENDABLE PERFORMANCE

Installation time for

–25 seconds per joint

Water flood system installed at speeds up to 880 ft. per hour

Outstanding success with Du Pont **DELRIN** acetal resin pipe has been reported throughout the oil patch. Typical of this experience is a water flood system recently installed in Kentucky. Twenty-two 1½" flow lines were installed at speeds up to 880 feet per hour. Most joints were made within 25 seconds, using the simple, fast integral joining method based on heat fusion.

In addition, considerable time was saved at the well-head, separator and field header hookups, because with **DELRIN** pipe the need for precision cutting and threading is eliminated. Installation time for these hookups was reduced from hours to minutes. And the pipe was immediately pressure-tested. In fact, as soon as the last joint is completed, you can pressure-test a **DELRIN** pipe line at 150% of the rated long-term operating pressure.

DELRIN pipe was developed by Du Pont specifically for use in oil and gas production. It is manufactured, sold and serviced by the Du Pont Company. Here's why **DELRIN** pipe can offer the economy of long, trouble-free service:

- ***It is the strongest and toughest thermoplastic pipe on the market today.*** **DELRIN** pipe retains its high strength and toughness properties over operating temperatures ranging from sub-freezing to 180°F. It is even stronger under pressure-surging conditions than under steady peak pressures, and does not lose strength by oil absorption.
- ***It resists corrosion,*** both internally and externally, and it resists paraffin build-up under most field conditions.
- ***It offers increased flow*** because of extremely low friction loss. For example, operating experience has shown that the flow rate for 1½" **DELRIN** pipe is comparable to 2" steel pipe.

DELRIN pipe has been tested in over 6 years of laboratory work by Du Pont and by over three years of field installation in various oil-producing areas of the country.

MAIL COUPON FOR FULL DETAILS, including engineering specifications and a detailed analysis of various field installations. You will also receive full information on all the sizes and prices of **DELRIN** pipe and the location of your local Du Pont technical representative serving the oil industry.

DELRIN™ PIPE

ACETAL RESIN

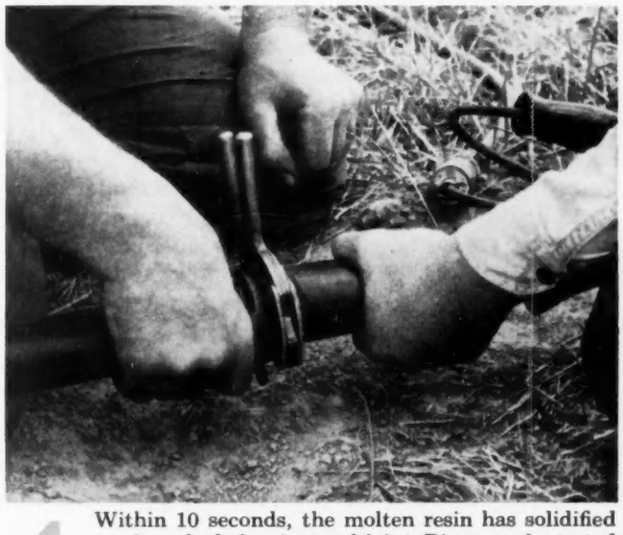
Manufactured, sold and serviced by Du Pont

Du Pont Delrin™ pipe

1 Operator clamps the cold ring around the pipe at point indicated by depth gauge, while helper aligns pipe. This ring insures proper insertion of the pipe into the coupling during the heating operation.

2 Pipe is inserted into female die of heating tool, a lightweight unit powered by a portable generator or other electricity source. Coupled end of pipe is being heated by male die of the tool.

3 After 15 seconds, tool is removed and the pipe end is quickly pushed into the coupling until the cold ring touches the face of the coupling. Both operators align pipe to be sure joint is straight.



4 Within 10 seconds, the molten resin has solidified to give a leak-free integral joint. Pipe may be tested at pressures up to 150% of the rated pressure. Total joining time: 25 seconds.

DU PONT

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

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Dept. WO-10 Room 2507P, Nemours Building
Wilmington 98, Delaware

Please send me complete information on **DELRIN** PIPE for oil-field installations.

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Position_____

Firm Name_____

Street Address_____

City_____ State_____

FIGURE 26—Simultaneous pipe running procedure using multiple slips and elevators.

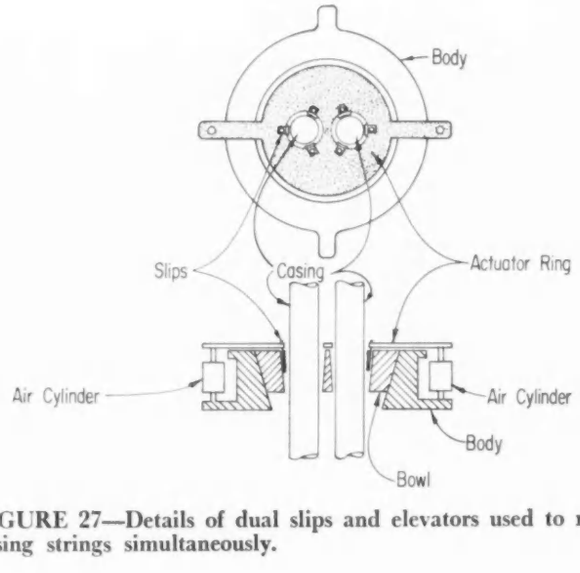


FIGURE 27—Details of dual slips and elevators used to run casing strings simultaneously.

3. Viscosity—42-45 sec.

4. Solids—as low as economically feasible

5. Weight—minimum required to maintain well control

6. Water loss—8 cc by cementing time.

Normally, calcium lignosulfonate thinners are used in lieu of phosphates since the latter type is unstable at higher temperatures (often encountered in the area) and because it is not compatible with cement.

During the hole conditioning period, close attention should be given the circulation rate. Because of the small ID casing, friction loss during pumping is excessive. In many cases, although moderately high pumping pressures are noted on the rig pumps, annular velocity remains low and inadequate for best hole cleaning action.

Thus, care should be taken to circulate the well at the maximum volumetric rate possible with rig equipment. If rig pumps are obviously inadequate for the job, consideration might be given to circulating the well with cementing pumping units.

Even though care is taken in maintaining good mud properties, advantages gained may be completely lost if proper attention is not given the time element between the last conditioning trip and actual cement placement. Time is important since lengthy exposure of mud to bottom hole temperature can result in appreciably altered properties, especially if temperatures are high. Thus, casing should be run and cemented as soon as the hole and mud system have been conditioned.

Several procedures have been developed to reduce the time factor:

1. Fill-up. Time can be saved by not filling float equipped or bull plugged casing strings during actual running operations. Strings equipped with latch type cementing equipment do not require filling since they are full-open and will fill automatically while going in the hole.

If multiple casing strings are run simultaneously, bull plugged strings can be filled after pipe is on bottom and while the hole is being circulated through the cementing strings. If casing strings are run independently, bull plugged strings can be filled after the last string is landed and while the cementing strings are being used to condition the hole prior to the cementing operation.

2. Pipe tally. All casing should be tallied prior to the running operation so that there will be no delay for pipe measurement.

3. Rack casing in derrick. If feasible, casing can be made up in stands and racked in the derrick prior to laying down drill pipe.

Following logging, casing may be run in the hole (in stands, since it was racked previously) with a salvage bit and latch type cementing equipment. Hole then is conditioned with the bit-equipped casing string, and re-

FIGURE 28—Guide plate used in rotary to align individually run casing strings with proper hanger receptacle in master hanger bushing.

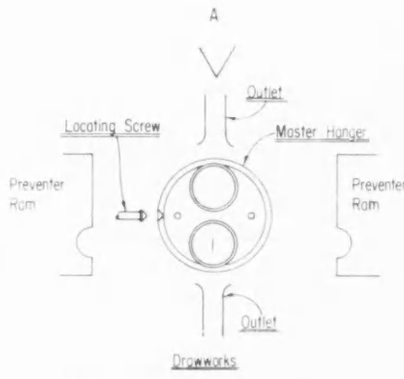


FIGURE 29A—Blowout preventer and hanger arrangement after landing first string of dual completion using individual running method.

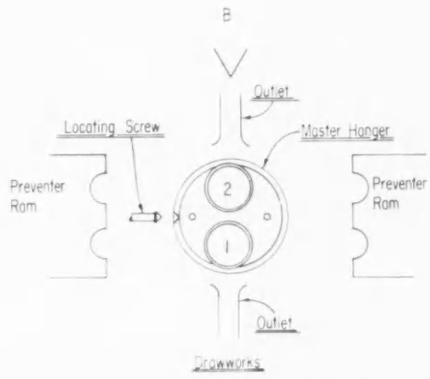


FIGURE 29B—Pipe, blowout preventer relationship during running of second string while circulating through first string.

maining strings are run. Pipe then can be cemented through the bit and remaining cementing string. Thus, a complete round trip, time normally required to lay down drill pipe and time required to pick-up and make-up casing from the rack are saved between conditioning and cementing.

4. **Run pipe at fastest rate considered safe practice.**

5. **Cement prior to installing tree.**

In addition to the above, many operators have eliminated testing of casing joints and drifting pipe while running operations are in progress. However, a leaky joint or a crooked string can lead to additional serious difficulties, perhaps requiring a workover job. Again, experience will have to be the guiding factor whether to test and drift casing strings during the running operation. In some cases, more care has been given make-up torque if connections are not tested during the running operation.

RUNNING PIPE

Two general methods have been used successfully to run multiple strings of casing. Pipe can be run individually with single hoisting equipment (Figure 25) or simultaneously with multiple elevators and slips (Figures 26, 27). The pipe running procedure selected depends on operator preference, time element involved in using a particular method, cost of additional pipe handling and BOP equipment required and the influence of a particular practice (such as reciprocating all casing strings simultaneously) on the cement job.

Although the individual method is used most often now, both procedures produce satisfactory results.

Running strings individually. Many operators prefer the individual running method because no extra pipe handling equipment is required. If the job is located in an area where mud properties deteriorate rapidly with time, the single running method may be desirable so as to get pipe on bottom as soon as possible for conditioning purposes.

Speed of running individual strings often is cited as an advantage. However, if a simultaneous running job is planned and executed properly, there is no significant time difference between the two methods.

Several procedures for running strings one at a time have been developed. This discussion will include those now in general use.

FIGURE 30—Hook-up used to circulate one string of a multiple parallel completion while running remaining strings. Short pup joint connection is made from seated hanger to top of bell nipple.

Assumptions:

1. At least two casing strings are equipped for cementing regardless of the type completion (dual, triple, quadruple).

2. Scratchers and centralizers are used.

3. Latch-type cementing equipment is used.

4. Wellhead equipment consists of a master hanger bushing and individual mandrel and/or slip type hangers.

Since some difficulty has been experienced in guiding strings through multiple casing hangers, some operators use a guide plate in the rotary to aid in aligning casing and the respective hanger receptacle.

As shown in Figure 28 the plate is bored eccentrically. When running casing, the plate is positioned in the rotary such that the plate receiver hole is aligned with the individual hanger seat in the master bushing. When subsequent strings are run, the plate is simply rotated until the hole matches the correct hanger receptacle.

Method A—Dual String

1. Run cementing string No. 1 to bottom using rams as shown in Figure 29A, install master casing hanger. Circulate out from bottom at maximum pumping rate while rotating and/or reciprocating pipe. Treat mud if necessary.

2. Install and land individual hanger (Figure 25) of string No. 1 in master bushing. Close blind rams, install dual port rams in top BOP as per Figure 29B. Use short pup joint hook-up from seated hanger to top of bell nipple (Figure 30), and connect string No. 1 into circulating system. Start pumps and circulate well during the complete time interval required to run string No. 2.

3. Run cementing string No. 2 and repeat circulating/

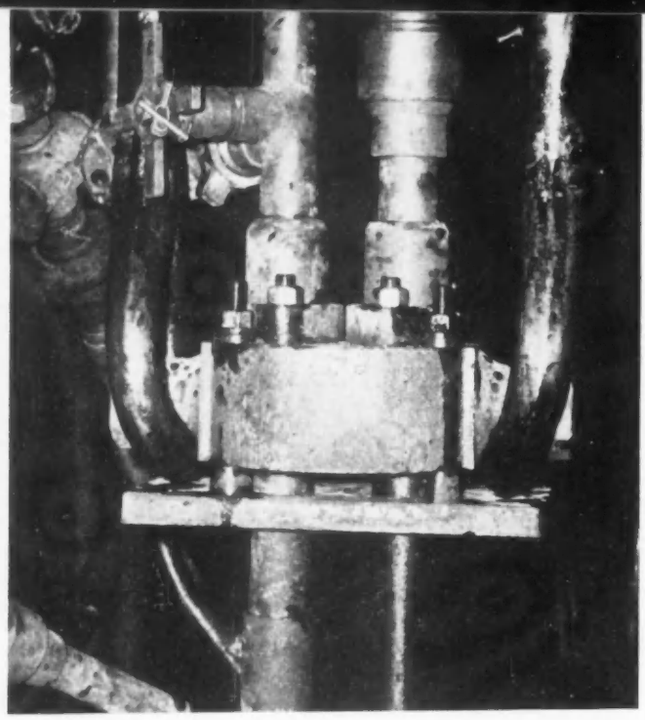


FIGURE 31—Dual casing string reciprocator for multiple small diameter wells.

reciprocating/rotating procedure in (1). Land string No. 2 in master hanger.

4. Pick up dual elevators (Figures 26, 27) or dual reciprocating equipment, install heads and pick up both cementing strings simultaneously. Figure 31 shows a dual small diameter casing reciprocator being used in a cementing operation. Figure 32 shows details of the tool. Cement well while reciprocating both strings and with both casing head outlets open. If casing begins to drag before cement has been displaced, lower and seat hangers in master bushing.

Method B—Dual String

1. Run cementing string No. 1 one-third of the distance to bottom. Break circulation, reciprocate and/or rotate pipe and displace hole at maximum pumping rate from that point to surface. Repeat procedure two-thirds distance to bottom and on bottom. Treat mud as required.

2. Install master hanger bushing, seat string No. 1 in hanger.

3. Run string No. 2 and repeat procedure in (1) above. Seat string in master hanger.

4. Rig up dual string elevators or pipe reciprocator, install dual port rams in top BOP, pick up strings simultaneously and nipple up cementing heads.

5. Cement well while reciprocating both casing strings. Continue scratching until weight differences indicate cement is setting. Slip type casing hangers are desirable because pipe is reciprocated after cement displacement and it is impossible to pre-determine when or where casing will stick.

Method C—Triple String

1. Run small diameter cementing string No. 1 to bottom at maximum possible speed using single rams in top BOP. Land master hanger bushing in head (See Figure 33A).

2. Break circulation and circulate out from bottom at maximum pumping rate while rotating and/or reciprocating pipe to prevent gelled mud from accumulating in wash-outs and to minimize wall cake build-up. Treat mud if necessary.

3. Install individual hanger, land cementing string No. 1 in master hanger bushing.

4. Run cementing string No. 2 and repeat procedure in (2) above. Land string No. 2 in hanger. Check cementing string No. 1 to determine if stuck. If necessary, work string No. 1 for short period while circulating, and re-seat in hanger.

5. Run bull plugged string with individual hanger, wash-out above BOP's and hook-up as described in Step 2, Method A. Install dual port rams in BOP (Figure 33B).

6. Pick up cementing strings individually, reciprocate pipe and circulate at maximum pumping rate for a total of 1-1½ hours, or a period commensurate with field practice. During circulating period, fill bull plugged string with oil through connection made previously under derrick floor.

7. Re-seat cementing strings in master hanger, remove fill-up connection from bull plugged string. Remove BOP's, install Christmas tree. Pressure bull plugged string to 500-1,500 psi.

8. Nipple up dual cementing heads on tree, cement casing.

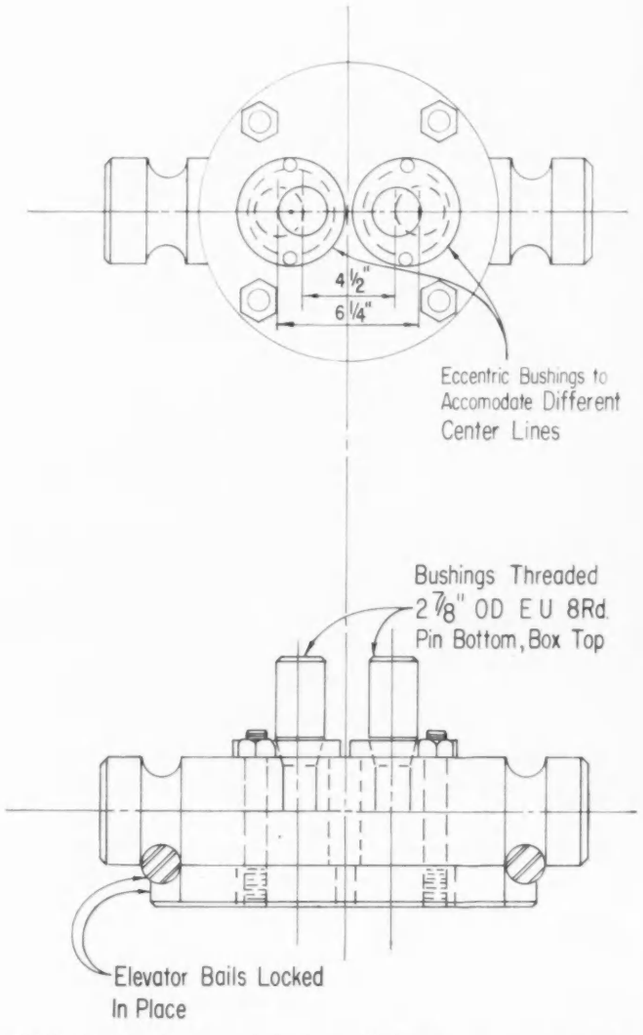
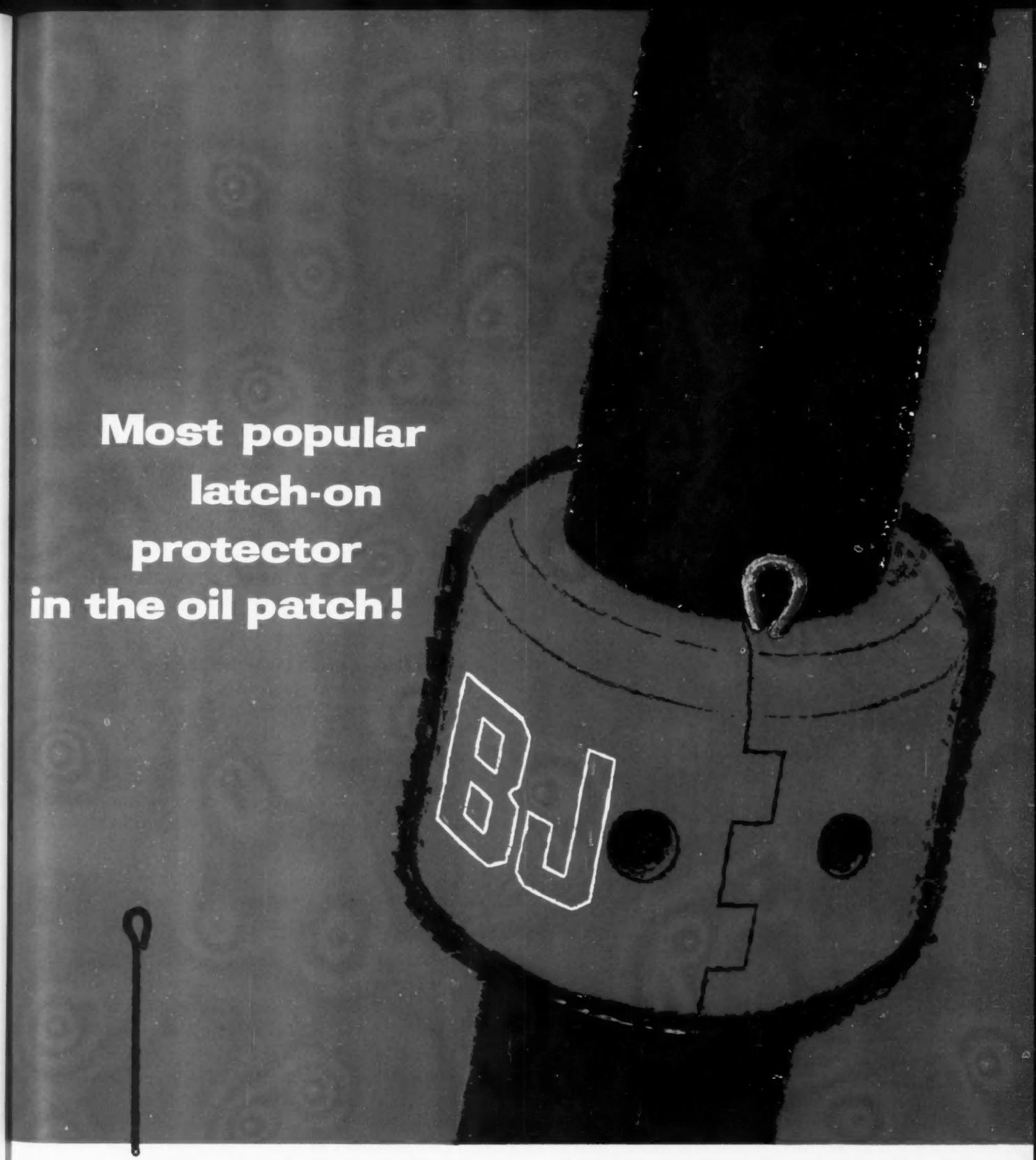


FIGURE 32—Details of dual small diameter casing reciprocator. Concentric bushings permit tool to be adjusted for correct hanger center lines on dual, triple or quadruple string jobs.



BJ Grip-Loks,® introduced a year ago, are already the fastest-selling, most popular latch-on protectors in the oil patch. And no wonder. Grip-Loks are competitively priced—can economically replace stretch-on type protectors in many field applications. Grip-Loks can be installed or removed by one crewman in seconds using simple hand tools... eliminate special handling of pre-rubbered pipe... more than pay for themselves in rig time saved! Tougher than a boot, too. They're made of a special BJ-compounded synthetic rubber, super-bonded to a steel inner cage. Sturdy, simple locking pin holds the protector in place without stress or strain. Grip-Loks won't move on the pipe. Available through supply stores.

Send for bulletin — (No. BJT-60-149), which gives details on BJ's full line of protectors — both stretch-on and latch-on types.

Byron Jackson Tools, Inc.
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BJ
QUALITY COSTS LESS IN THE LONG RUN

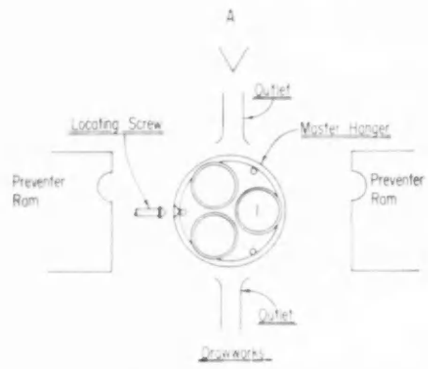

FIGURE 33A—Blowout preventer and hanger arrangement after landing first string of triple string completion.

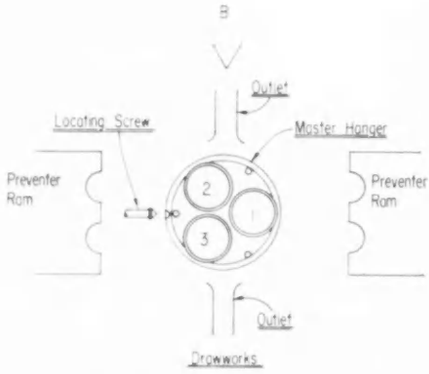

FIGURE 33B—Pipe, blowout preventer relationship while filling bull plugged string No. 3 with oil; reciprocating and circulating through strings 1 and 2 individually.

From the preceding discussion, it is obvious that many combinations of running procedures can be applied to any particular job. Thus, area experience again will be a decisive factor in selecting the proper individual running method.

Regardless of the procedures used, the following points should always be kept in mind:

1. Keep mud in optimum condition.

2. Circulate hole at high rate between each string run, preferably in conjunction with pipe reciprocation or rotation.

3. Centralizers are essential in multiple string wells to keep strings separated from the bore hole wall and from each other.

4. Always fill bull plugged string with oil or water, never mud. Take care that mud is not splashed into bull plugged strings while running other pipe.

5. Always check to be sure metal centralizer banding or junk has not become lodged under individual casing hangers.

Method D—Quadruple String

This procedure has been used where difficulty has been encountered in freeing cementing strings after they have been seated in the hanger for the time required to run subsequent strings.

1. Install master casing hanger bushing. Align top BOP rams with diagonal holes as per Figure 34A (turn upper preventer 45° to right).

2. Run bull plugged string No. 1, fill with oil, install individual hanger with back pressure valve and seat in master hanger.

3. Close blind rams, reverse rams in top BOP to align with second string. Run bull plugged string No. 2 as per (2) above.

4. Rotate top BOP clockwise 90° as per Figure 34B to align rams with remaining holes in master hanger.

5. Run string No. 3 (cementing string No. 1) to bottom. Circulate well completely around at maximum rate while working pipe. Treat mud, if required.

6. Land string No. 3 in master hanger. Close blind rams and install dual port rams in top BOP (Figure 34C). Nipple up circulating connection on string No. 3 as per Step 2, Method A.

7. Run string No. 4 (cementing string No. 2) to bottom while circulating through string No. 3. Wash out BOP's above hanger, land string No. 4.

8. Remove connections from strings 3 and 4, nipple up on String No. 1 with landing joint, pressure to 500-1,500 psi and install safety caps. Repeat procedure on string No. 2.

9. Nipple up on strings 3 and 4, install dual string elevators or reciprocator. Circulate medium depth holes for 1-1½ hours while reciprocating strings simultaneously.

10. Rig up cementing heads, cement well while reciprocating. Seat hangers when plugs are released and complete slurry displacement.

11. Test casing (strings 3 and 4), bleed back to pressure commensurate with field or company practice.

12. Remove safety caps from bull plugged strings 1 and 2, release pressure, remove back pressure valves.

Running strings simultaneously. Multiple slip and elevator equipment are required for this procedure (Figure 27), which may be preferred over the individual running technique because:

- It eliminates sticking one or more cementing strings. As mentioned previously, pipe run initially by the individual string method sometimes sticks because of the length of time spent at rest during running of subsequent strings.
- It reduces chances that casing strings will become tangled or twisted while running.
- It allows entire casing bundle to be reciprocated.

Simultaneous running of casing offers one disadvantage with respect to time. Since it takes longer to make up all strings and run them concurrently than it does to install a *single* string of a multiple bundle of casing by the individual method, the time factor from the last conditioning trip to the first *circulating* period is longer if pipe is run simultaneously. This does not mean that total time from the last trip with the bit to *cementing* is reduced since simultaneous running time is comparable to the total time required to run all strings individually. In fact, many operators report that they can reduce *total* running time significantly by using the simultaneous running method.

Thus, it is a matter of choice as to the method employed. If it is believed that the early circulation provided by individual running is advantageous, that method should be used. However, if simultaneous movement of the entire casing bundle during the cementing operation

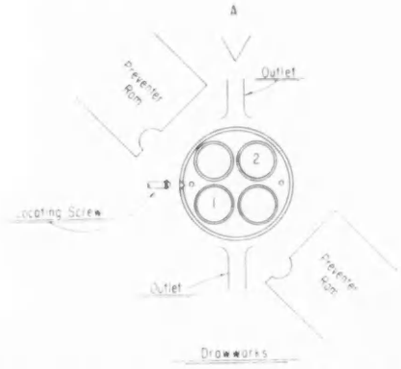

FIGURE 34A—Blowout preventer and hanger arrangement while running first and second strings of quadruple string completion. Rams are reversed to align with string No. 2 prior to running.

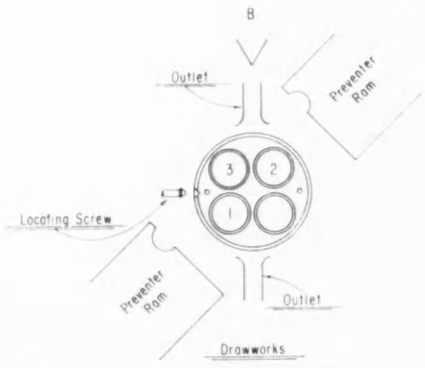

FIGURE 34B—Upper blowout preventer is rotated 90° to match rams with diagonal formed by individual hanger seats 3 and 4 prior to running string No. 3 (cementing string No. 1).

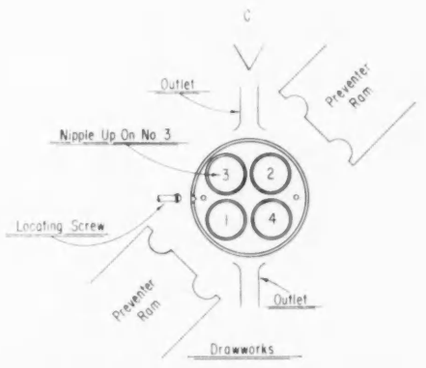

FIGURE 34C—After landing string No. 3 and nippling up circulating connections, dual port rams are installed in top blowout preventer prior to running final string (4).

is considered essential and if it is desirable to positively eliminate sticking of individual strings, pipe should be run concurrently.

Procedure:

1. Use dual port rams in top BOP, or stripper head on top of BOP assembly (Figure 35) if more than 2 strings are run.

2. Use multiple slip/elevator equipment to run all casing strings to bottom concurrently. Reciprocate bundle, circulate at high rate, treat mud.

3. Set casing in multiple slips, pick up, reciprocate strings individually and circulate to break gels between strings while filling bull plugged string(s) with oil.

4. Install master hanger, rig up cementing heads, cement pipe while reciprocating entire casing bundle.

Christmas tree installation. Once casing has been run in the hole, a decision must be made whether to install the tree prior to cementing. Presently, most operators nipple up the tree prior to cement displacement, chiefly because of economics. If the tree is in place, the rig may be released as soon as plugs are bumped and additional rig time during the WOC period is saved.

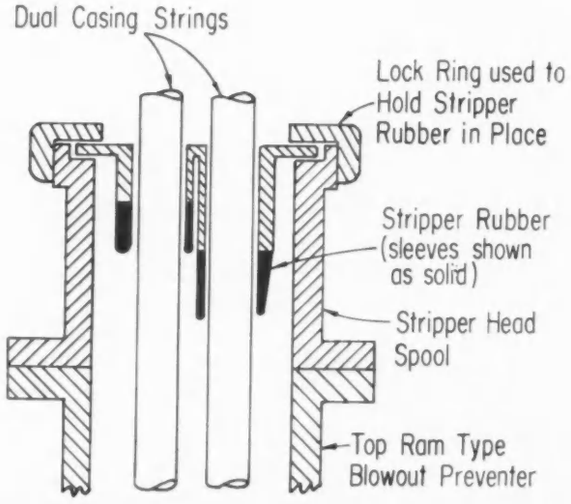
Dual Casing Strings
Lock Ring used to Hold Stripper Rubber in Place
Stripper Rubber (sleeves shown as solid)
Stripper Head Spool
Top Ram Type Blowout Preventer

FIGURE 35—Stripper head used for blowout protection if more than two strings are run simultaneously. Pressure on head causes rubber sleeve element to pack-off on pipe.

Conversely, there are several reasons for not following this procedure. First, strings cannot be reciprocated individually or simultaneously during the actual cementing operation. Second, strings cannot be hung in tension to relieve the buckling or crooked pipe problem. And third, mud will remain static in the hole (with the possibility that properties will be affected adversely) for a longer period of time just prior to cementing since BOP's have to be removed and the tree installed. This slightly increases the over-all time interval between the last conditioning trip with the bit and cementing by the length of the nipple up period.

There has been much controversy as to the effect of pipe movement during the cementing operation. Since successes and failures have occurred both with the tree in place and when pipe was moved, neither method presently can be considered the "best" for all operational areas.

On the basis of experience, however, the following generalization can be made: if a multiple string well is located in an area with known primary cementing or casing bucking problems, the tree should not be installed prior to displacing cement, and pipe rotating/reciprocating practices should be followed until cement displacement is completed. Again, it should be emphasized that this is a most controversial subject which will probably never be resolved to the satisfaction of all operators.

This procedure is relatively cheap insurance because of the complicated annular geometry of multiple string wells, especially if the individual running technique is used and strings become intertwined. Individual and simultaneous movement of pipe is about the only means that can be used to break gels and mud cake lodged between strings and between the bundle and bore hole wall.

As in the case of so many other operational procedures relating to small diameter well completions, the proper course chiefly depends on experience in a particular area.

Block squeeze for positive isolation of producing zones. Some operators have made block squeezing of each potential producing interval prior to completion standard operating procedure. In such cases, squeeze jobs are performed either through oriented perforations opposite each zone or through circulating sleeves spaced below each interval.

The procedure used in perforating and squeezing is

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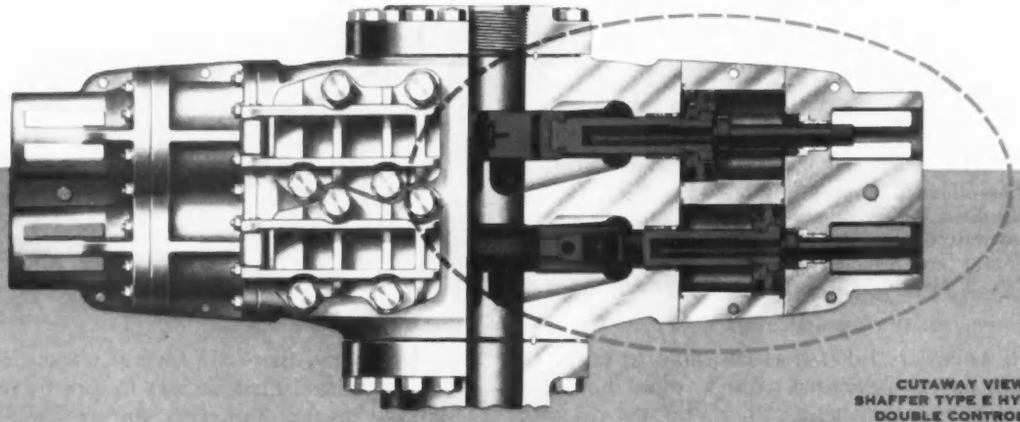

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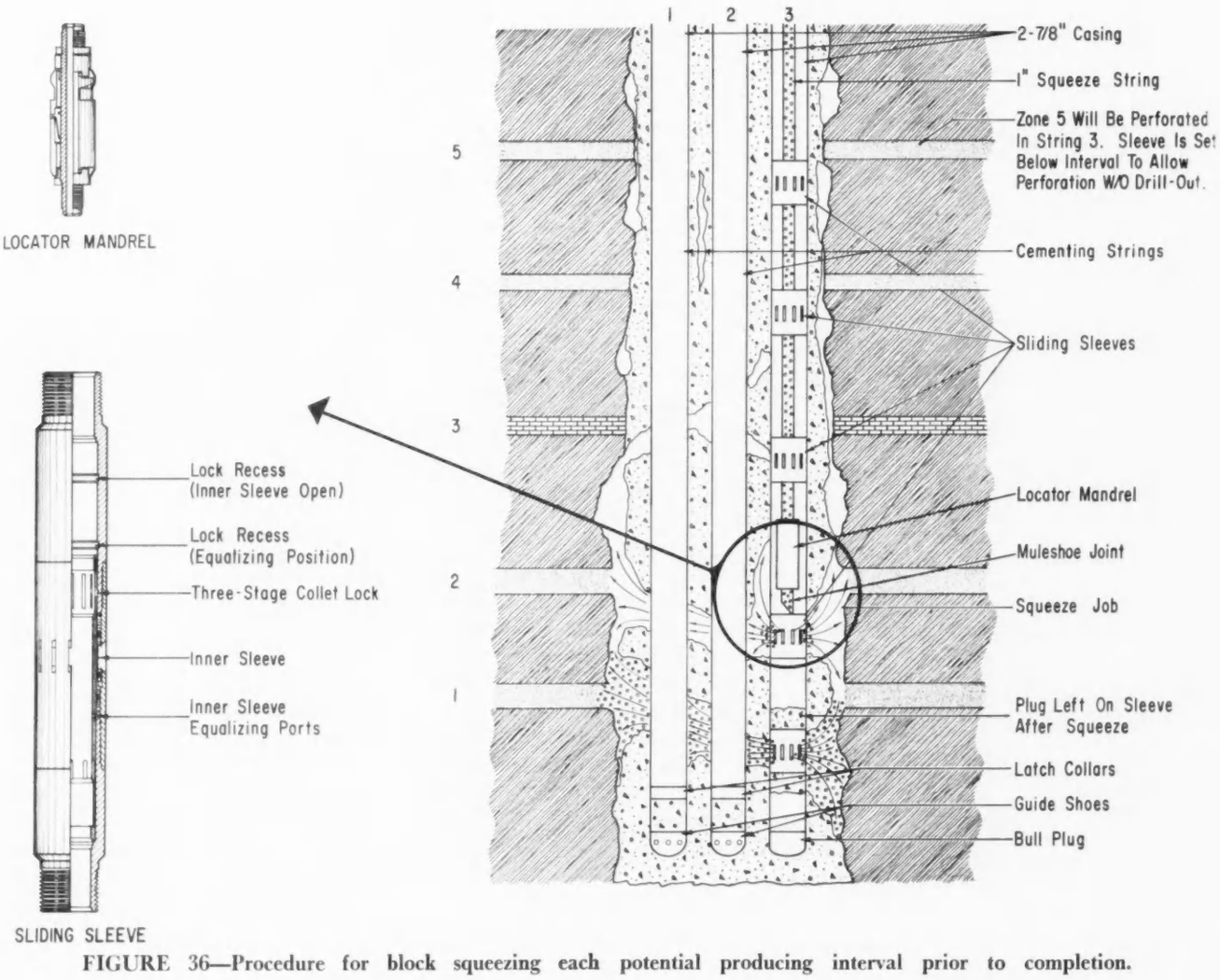

FIGURE 36—Procedure for block squeezing each potential producing interval prior to completion.

similar to the conventional concentric tubing workover-squeeze method (Page 135, World Oil, March 1958) except that oriented perforating techniques are used. Because of this close similarity, this particular procedure will not be discussed further.

Block squeeze procedures utilizing circulating sleeves are of interest since they are unusual and have only recently been applied. Initially, casing is run by any of the methods discussed previously; however, one of the bull plugged strings is equipped with circulating sleeves (Figure 36) spaced just below each potential producing zone. Sleeves are run in the hole in the closed position.

Once pipe is on bottom, the well is cemented through the cementing strings as has been discussed previously. The drilling rig then is moved off location and a small completion rig or pulling unit capable of handling 1-inch tubing is moved on the well.

A string of 1-inch tubing with a locator mandrel (Figure 36) on bottom is run to a point below the lowest sleeve in the bull plugged string. As the 1-inch pipe is picked up through the sleeve, the locator mandrel, which serves as a shifting tool, engages and opens the inner sleeve element. The 1-inch string then is positioned above the sleeve and a bradenhead squeeze is performed on the exposed formation. Excess cement then is reversed out. A short plug is usually left in the casing above each sleeve.

The 1-inch string then is picked up and positioned just below the next highest sleeve. After WOC (waiting period dependent on type cement used), the first squeeze job is tested to squeeze pressure.

If the squeeze fails to hold, the job may be repeated. If the squeeze tests OK, the 1-inch is picked up through the next sleeve up-hole thus opening it and exposing the second interval. The same procedure is repeated through each sleeve until all zones have been squeezed and pressure tested.

The sleeve equipped bull plugged string is directionally perforated and completed in the upper-most zone to eliminate drill-out of cement in the sleeve areas below.

As indicated, the primary cement job has ample time to set and cure prior to the squeeze operation. If a good cement job is indicated by inability to break down a specific interval, the 1-inch workover string is simply picked up and the zone opposite the next sleeve up-hole is checked.

It is of interest that little difficulty has been experienced in opening the sleeves even though the primary cement job has set.

ACKNOWLEDGMENT

The author wishes to thank the many operators, drilling contractors, service companies and manufacturers whose cooperation and contributions made this section of Engineering Practices Report No. 4 possible. A detailed reference list and acknowledgment will be included with the last installment of the series.

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Kingfisher County--- hottest oil play in U.S.

Some 40 rigs active in area that was considered an oil and gas graveyard three years ago

By John Woncik,
Exploration manager, Mid-Continent Area, Apache Corporation, Tulsa

THREE YEARS AGO, Kingfisher County, Oklahoma, was considered a graveyard in respect to oil and gas potential.

Today, 500 tests and 450 producers later, that same north central Oklahoma County is the scene of the hottest oil play in the United States.

Some 40 drilling rigs are hard put to keep pace with an average of one new well every three days.

And the potential appears to be only half reached.

Multiple pay zones and multiple allowables, large stratigraphic traps, and wide spacing are among the factors accounting for the phenomenal play.

Less than four years ago, only 134 wells had been drilled in this county of 25 townships, of which 94 were producers, mostly from the Hunton limestone. Then, operators considered Kingfisher plays as "too deep," "lacked good reservoirs," and had "no structures" because it was "too far west of the Nemaha Ridge."

Presently, more than 500 wells have been drilled resulting in more than 450 producers with most of the production coming from the Manning, Meramec and Oswego. Many operators consider Kingfisher County the nation's hottest oil play and likely to remain so for some time to come.

In 1958, the Oklahoma Corporation Commission granted 80-acre oil spacing. Previous development in the county had been on 40 acres. The wider spacing pattern greatly reduced initial investment and attracted the independent and major companies to the area.

But the most important reason operators are attracted to Kingfisher County is the high success ratio in development and stepout drilling. This high success ratio results from big pools occurring in large traps.

Five years ago, leases cost $2 per acre; today, renewals are for $20 an acre and up. Operators are scrambling to evaluate their leases before they expire. Farmouts have accounted for most discoveries and a large part of the development drilling. Leases taken at top prices in the past two years probably will see evaluation before they expire. Operators are reluctant to pay top prices the second time around, so the intensive drilling looks as if it is going to last for two or three more years.

Independents active. Representation by majors and independents is about split. Texaco has drilled over 40 wells in one pool. Humble, Shell, Conoco and Pan American have participated in widespread drilling throughout the county.

The independents have been very active. Jones-Shelburne-Pellow, Calvert, Apache, Keener, Oil Capitol, Harper, King-Stevenson, and many others have drilled several wells each. A list of all the operators in Kingfisher County, who are at present completing wells, reads like an oil directory. Activity is so intense it sometimes takes two hours to phone out a morning drilling report from Kingfisher County. Service companies have moved field camps into Hennessey and Kingfisher, cities which previously were wheat centers.

Geology. The eastern boundary of Kingfisher County lies approximately five miles west of the Nemaha Ridge. The Anadarko Basin begins its rapid plunge in a southwestward direction across the county.

Surface rocks are of Permian age.

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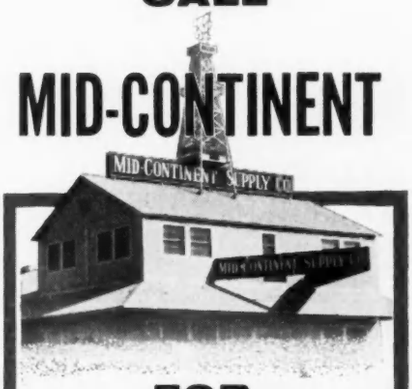

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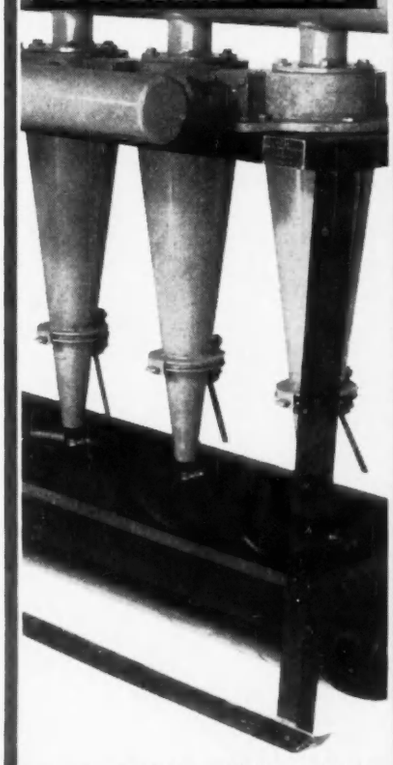
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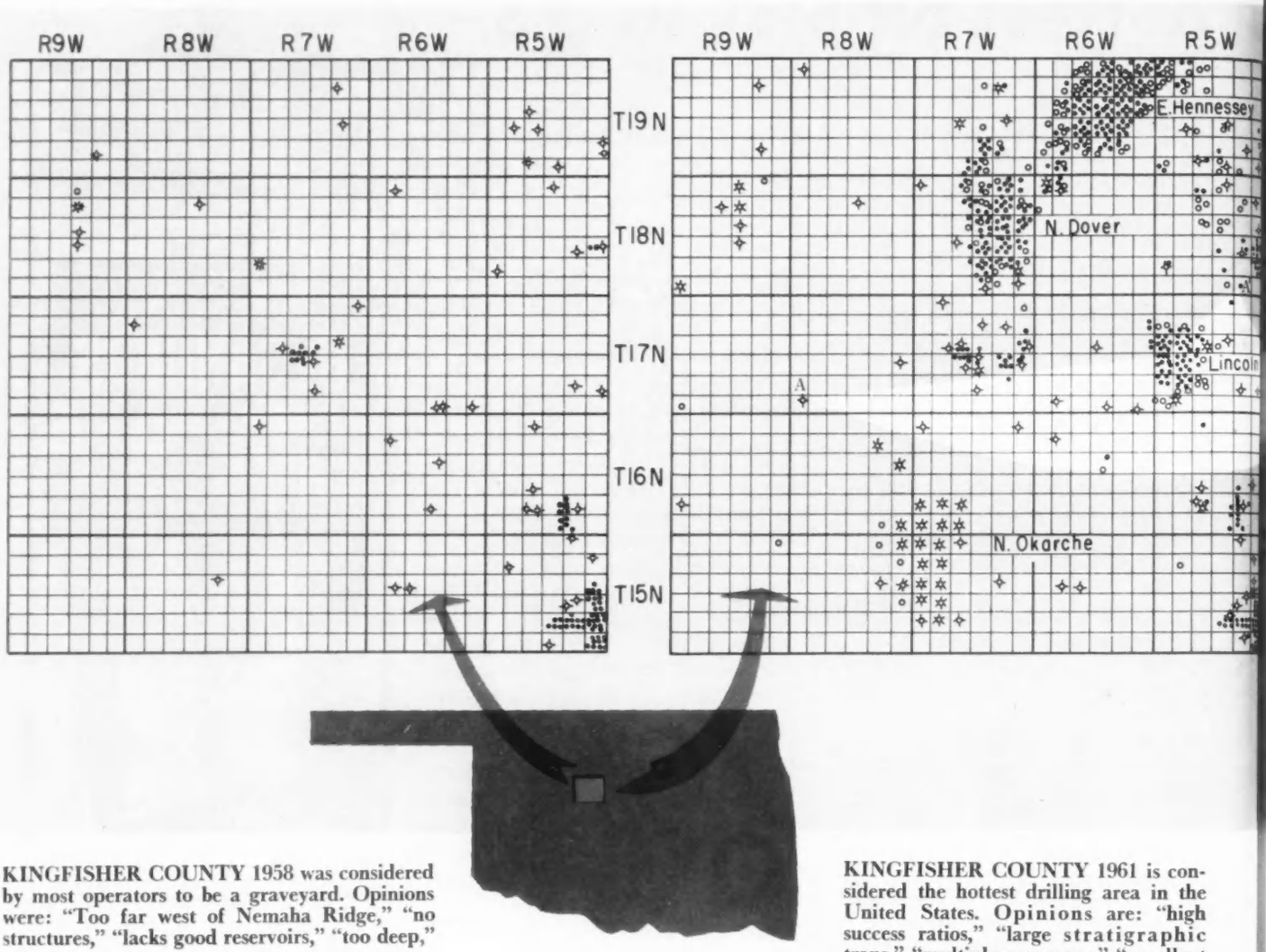


KINGFISHER COUNTY 1958 was considered by most operators to be a graveyard. Opinions were: "Too far west of Nemaha Ridge," "no structures," "lacks good reservoirs," "too deep," etc.

KINGFISHER COUNTY 1961 is considered the hottest drilling area in the United States. Opinions are: "high success ratios," "large stratigraphic traps," "multiple pay zones," "excellent investment return."

To date, no production has been found in the Permian, which consists of red shales, sandstones, and thin limestones occurring to a depth of approximately 2,800 feet. Underlying the Permian is approximately 4,500 feet of Pennsylvanian sediments. Production occurs in the Layton sand, Cleveland sand, Oswego lime, and Red Fork sand. In every case, accumulation of oil and gas is due to stratigraphic entrapment.

Rate of dip across the county is 50 feet per mile in the Pennsylvanian sediments. The Oswego lime is encountered at a depth of 6,000 feet on the eastern side of the county and dips to a depth of 7,500 feet in the 30 miles across the county. The rate of dip in the Mississippian sediments is greater because of truncation and on-lap of lower Pennsylvanian and Chesterian rocks.

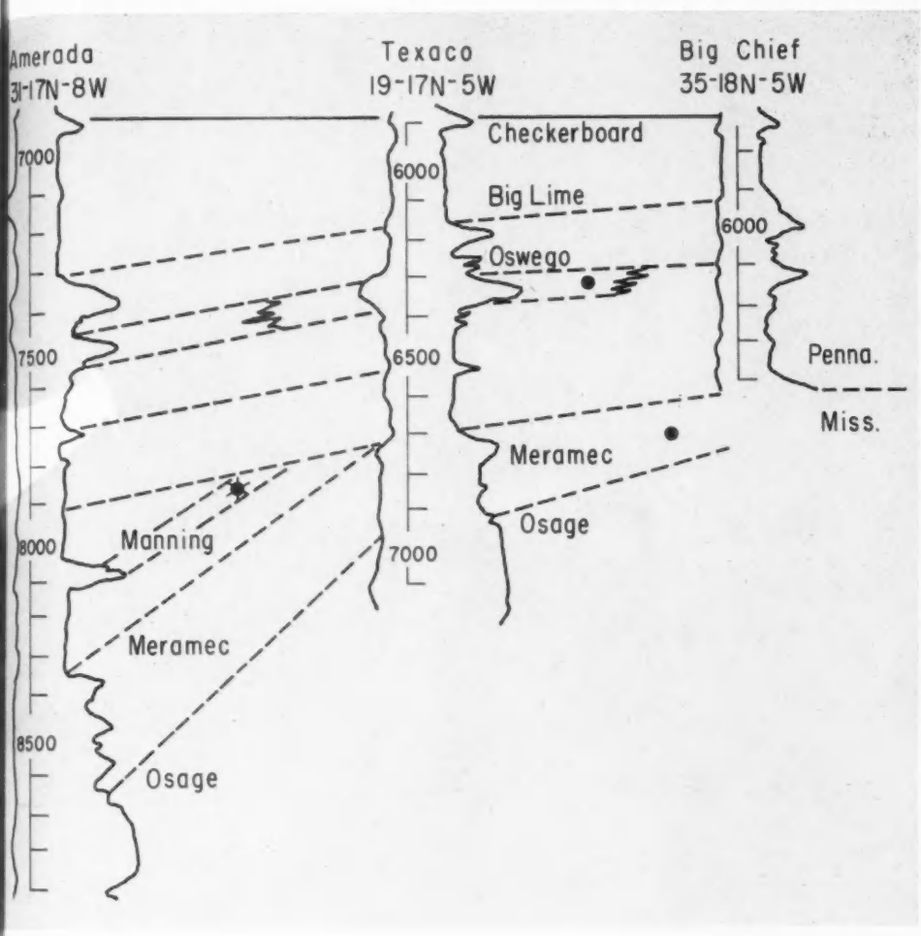
The Meramec occurs at a depth of 6,400 feet on the east and 9,000 feet on the western side. Rate of dip on the Meramec is 80 feet per mile.

Cross section A-A′ illustrates the increase in dip below the Mississippian unconformity and the role it plays in entrapment of hydrocarbons. The Mississippian unconformity truncates the Manning through Ranges 6 and 7 West, and serves to entrap hydrocarbons at North Okarche, North Dover, and East Hennessey.

The Manning at North Okarche is primarily a sandstone, while at North Dover and East Hennessey, it is a sandy lime. The Meramec sub-crops immediately to the east of the Manning truncation and thins eastward, due to truncation. The Meramec, although a dense amorphous lime, has become an important producing zone in Kingfisher County.

Secondary porosity appears to have been created in the Meramec due to a fracture system development on the hinge line of the Anadarko Basin. The truncation, plus weathering and subsequent sealing of the fracture system by the overlaying Pennsylvanian shales, have formed a vast area of oil accumulation in the Meramec, occurring adjacent and coincident with the Manning truncation.

Cross-section A-A' shows truncation of Meramec and Manning, and porosity development in the Oswego



Lower members of the Mississippian, not exposed to the unconformity, have not yet been found to be productive. Mississippian sediments in the county range in thickness from 400 feet on the east to 1,000 feet on the west.

Below the Mississippian is the Woodford shale which maintains a fairly uniform thickness averaging 35 feet. The Hunton lime occurring immediately below the Woodford, made up most of the production in the county prior to present drilling activity. Again, truncation, in the uppermost member, the Bois D'Arc, accounted for oil entrapment in the southeastern part of the county, in the West Edmond and Cashion pools.

To date, no Ordovician production has been found in Kingfisher County. The Wilcox and lower Simpson oil accumulation almost always is associated with structure and very few tests have been drilled to the Wilcox. The expense of prospecting for the smaller size deep targets in the Ordovician has been a deterrent.

Present exploration and development results from subsurface studies. Oil accumulation in the Oswego, Manning, and Meramec is stratigraphic in nature. Surface geology or seismic work is of little help in outlining the porosity development and truncation lines.

Hottest areas. Four pools account for most of the present activty in Kingfisher County:

North Okarche, discovered in 1958 by Calvert Drilling Company's Grummer I. The Manning was completed for 13 MMcf daily.

A key extension was drilled 18 months later by the Apache Corporation. The Apache Snow I was completed in the Manning for 25 MMcf daily. Rapid developmental drilling followed, resulting in 17 gas wells completed on 640-acre spacing.

The trap is formed by the truncation of the Manning. The producing zone is a sandstone, as opposed to a sandy limestone in other Manning production in the county. Porosity average is 10 percent.

Completions are effected by setting through the pay, perforating and using water-frac treatment. A single zone completion in the Manning results in an average per well reserve of about six million cubic feet.

Completed wells cost about $100,000. Gas is being sold to Oklahoma Natural Gas for 15¢ per thousand. Approximately four barrels of 60° condensate is produced per MMcf. Depth to the Manning is 7,900 feet.

Southeast Lincoln, discovered in late 1958 by Texaco's Ash I. The well was drilled on a seismic lead but discovered a large porosity trap in the Oswego limestone of Pennsylvanian age.

More than 40 developmental wells, and no dry holes, have been drilled to date. The more recent wells have been drilled to the Meramec of Mississippian age and have been dually completed.

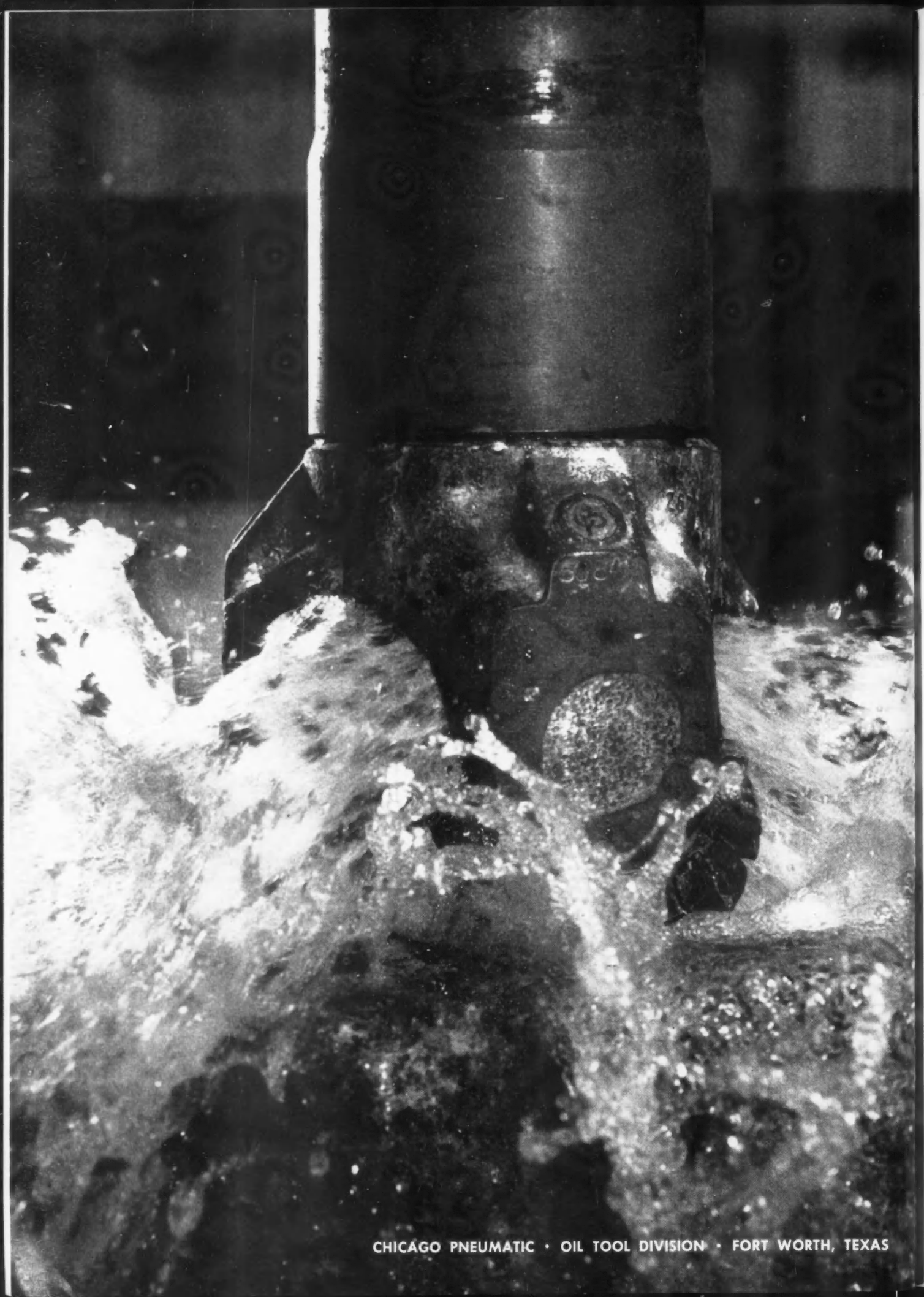
Porosity in the Oswego averages 13 percent and a recovery factor of 70 barrels per acre foot is most widely used. Some completions in the Oswego set through the pay zone, perforate, and use an acid-frac treatment. Many open hole completions are also employed in the Oswego when single completions are effected.

Gravity of the crude is 44°. Depth of the Oswego is 6,300 feet and the Meramec occurs at 6,700 feet.

North Dover was discovered in late 1958 by Jones, Shelburne & Pellow's Meyers I. The well tested more than 5,000 feet of oil on drill stem test from the Manning and was completed as a natural well flowing 17 boph.

More than 60 wells have been drilled in this pool. The Oswego and Meramec have proven productive in many of the subsequent wells. Again, stratigraphic trapping conditions account for the oil accumulation in all the pay zones.

Production practices usually follow the pattern of setting through the Oswego and Manning and completing through perforations. The Manning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is primarily a limestone in this area and requires acid treatment to stimulate flow. The Manning porosity here averages 9.5 percent and is considered to have a recovery factor of approximately 75 barrels per acre foot.

Gravity of crude from the Manning is 38°. The Manning occurs at 7,000 feet, the Oswego at 6,500 feet, and the Meramec at 7,250 feet.

East Hennessey is credited to Jones & Pellow in early 1959 by the drilling of the Schimanek I. This well recovered mud on drill stem test from the Meramec.

Tubing was run with packer and a good show of oil was swabbed. A permanent 5½-inch production string was run and the Meramec lime was completed open hole with 5,000 gallons acid treatment. Initial flow was 175 bopd of 39° gravity oil.

To date, more than 75 wells have been drilled in the East Hennessey pool. The Manning has produced in most of the subsequent wells. Several triple completions have been made with the Cleveland sand being the third zone.

The trapping mechanism is the truncation of the Manning and Meramec and a sand bar trap in the Cleveland sand. The Meramec is a low porosity lime, having porosity of only three to five percent. Fractures in the lime aid in permeability and increase the porosity somewhat.

Operators set casing on top of the Meramec to avoid lost circulation and contamination of the zone, and then drill into the formation approximately 100 feet with air, gas, or oil, and treat the open hole with acid and sand oil for final completion. Setting on top of the Meramec also insures having the fracture system exposed to treatment.

Most operators drill approximately 100 feet of Meramec, but it is believed only about 40 feet of effective pay exists in the zone. Reserve estimates vary, but the majority of operators place the per-acre recovery at about 1,000 barrels, resulting in an approximate 80,000 barrels per well recovery. At least one major company is cementing tubing for the permanent production string.

The Meramec occurs at 6,700 feet; the Manning at 6,400 feet; and the Cleveland at 5,900 feet.

Multiple completions preferred. Kingfisher County single zone oil completions approached a non-commercial payout rate, because of low allowables. Thus, dual completions are sought to speed up payout time, as well as to increase reserves.

The Meramec is looked upon with some skepticism and is considered to be another possible "Spraberry." The dual and triple completions in the other zones protect against this possibility.

Everything considered, there is plenty of optimism about Kingfisher. The number of wells being drilled expresses this optimism. Presently, the eastern half of the County is receiving the greatest attention.

Potential remains in the western portion of the County in other truncated members of the Manning. More Oswego porosity traps have yet to be found. Several Pennsylvanian sands offer sand bar traps. The first structural Wilcox oil has yet to be found.

Kingfisher County potential appears to be only half reached.

—The End

About the Author

John Woncik is division exploration manager with the Apache Corporation, Tulsa. He is a graduate of the University of Tulsa, and received his M.S. degree in geology from the University of Minnesota in 1951. Woncik worked for Warren Petroleum Corporation from 1951 to 1953, and for W. C. McBride, Inc., from 1953 to 1955. His present company, then the Apache Oil Corporation, started in business in 1955, and Woncik helped organize the geological department.

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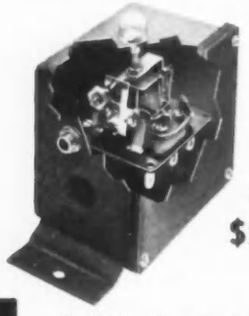

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How oil firms handle conflicts of interest

Since the Chrysler incident of last year, U.S. corporations have lost no time issuing written policies concerning employes with interests that conflict with their employers' welfare

(Editor's note: Lloyd F. Thanhouser, vice president and general counsel for Continental Oil Company, recently surveyed 79 major corporations to determine their conflict-of-interest policies and procedures. From that study a suggested policy was prepared and submitted to the company's board of directors.

On these pages is the first complete report published concerning the new emphasis being placed on written policies concerning conflicts of interest, factors to consider in setting up a policy, plus the new policy prepared for Continental Oil Company.

The ideas presented are applicable to the large and small company alike.)

PRIOR TO JUNE 30, 1960, only one out of ten large American corporations had issued general policy statements concerning employes with interests that conflicted with the welfare of their employer.

Twelve months later the ratio was reversed.

The event that triggered this revolution in corporate practice was the revelation at the end of June last year that the president of Chrysler Corporation had resigned under fire because he had been found to have profited from undisclosed interests in some of his company's suppliers.

The Chrysler incident, together with one or two others of somewhat similar nature, received widespread, sensational coverage in the press. This, in turn, stirred up a lot of activity by professional deplorers, volunteer do-gooders and vote-hungry politicians.

As a result, false impressions were created, namely, that the isolated cases of impropriety or indiscretion on the part of a few high officials were typical, that extremely low ethical standards (if any) prevailed in many large corporate organizations. There was no justification in fact for bestowing this black eye on big corporations generally, but many uninformed citizens were persuaded that the ugly adornment had been well earned.

About the only rewarding consequence of a black eye is that it teaches the recipient a lesson. The "shiner" hung on corporations during the summer of 1960 at least had that salutary virtue. It caused company managements all over the country to make sure that their own houses were in order and to scrutinize and revise their existing policies and procedures. It also emphasized once again the constant necessity for gaining and maintaining public confidence in the integrity of private free enterprise system.

Before Chrysler. The fact that only 10 percent of the large corporations had issued general statements concerning conflicts of interest before June 1960 did not mean that such policies were non-existent or that safeguards against possible duplicity on the part of employes were lacking.

About 90 percent of these big corporations relied on the well understood principle that an obligation of undivided loyalty is implicit in the relationship of employe to employer. It seemed rather silly, if not downright insulting, to remind high-placed management people that they were supposed to be working for the company and not for themselves. No need appeared for proclamations that "honesty is the best policy" or that "no man can serve two masters."

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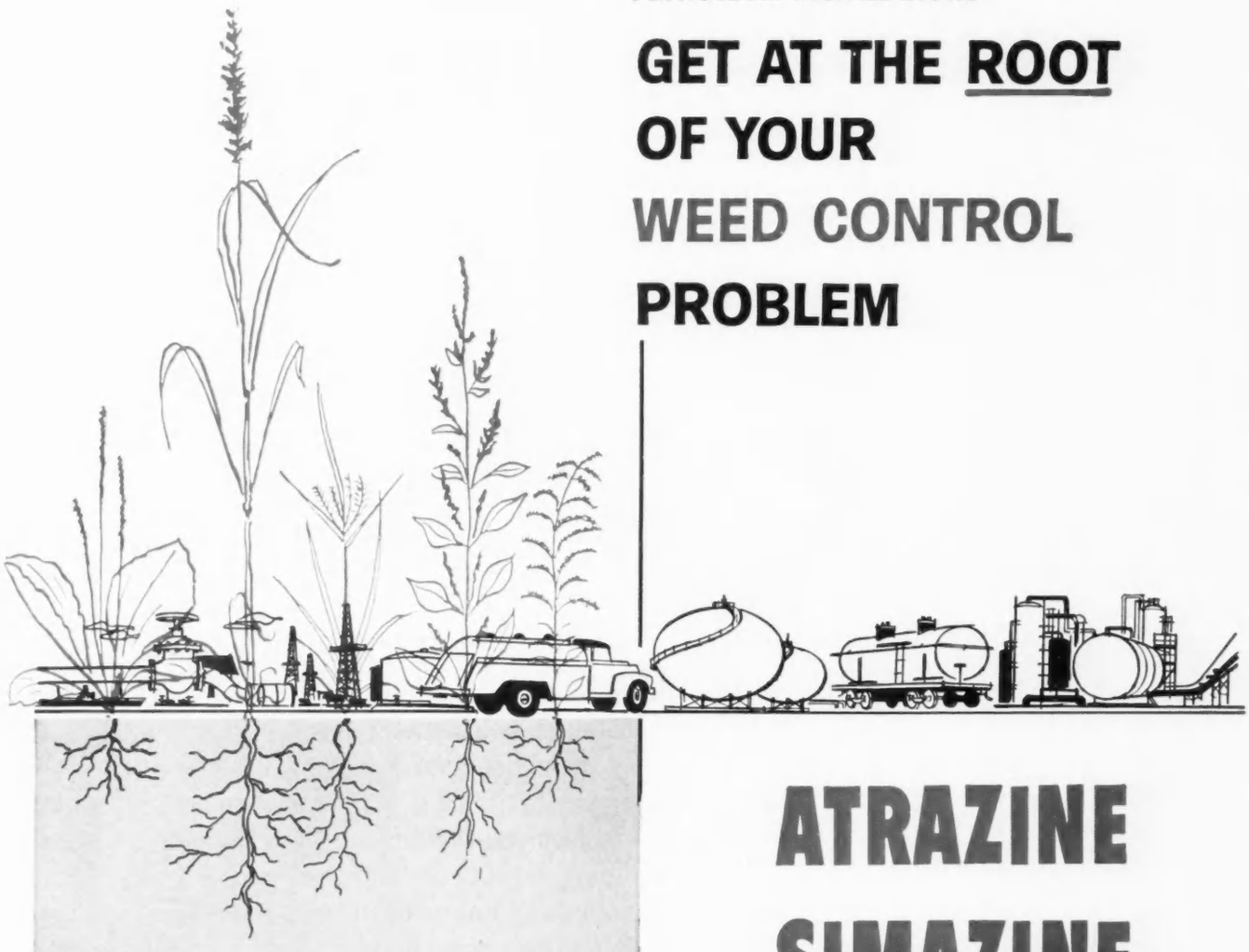

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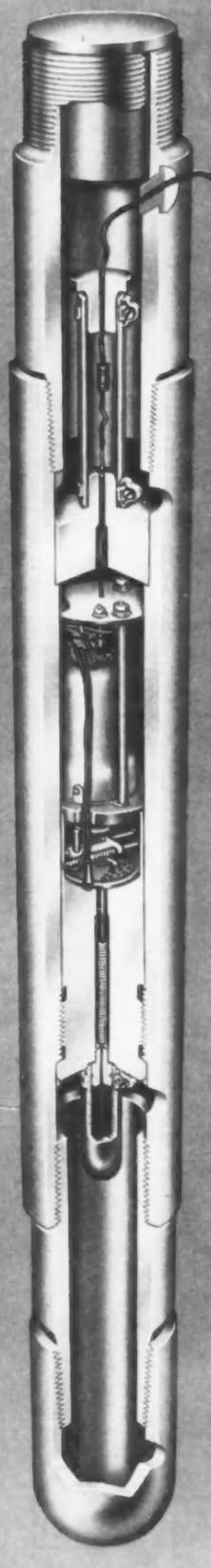

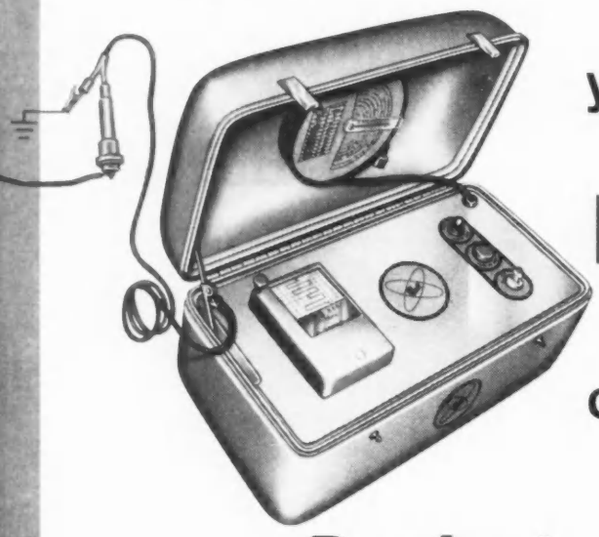

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Ben Franklin and the Bible had taken care of those announcements.

Furthermore, most of these large companies had adopted measures to detect and prevent any possible disloyalty in specific business areas. Such protective measures included:

- Selection of suppliers and manufacturers on the basis of competitive bidding.
- Rules prohibiting oil company employes from personally acquiring mineral interests.
- Contractual provisions that the company would own all inventions conceived by research personnel in the course of their employment.
- Instructions that expensive Christmas gifts must be returned if received from firms doing business with the company, plus intricate systems of internal audit and executive controls.

After Chrysler. It is surprising to find, therefore, that today approximately 90 percent of the largest corporation in this country—compared with 10 percent a year ago—have more or less elaborate directives laying down explicit rules and regulations with respect to conflicts of interest.

What is more, about three-quarters of these companies have called upon all their officers and managerial personnel to disclose the most intimate details of their private affairs. This drastic change in corporate practice was deemed to be of such importance that almost invariably the change was announced and explained by the chief executive officer of the company. And more than a quarter of the corporations which put such changes into effect felt it expedient to do so pursuant to formal resolution adopted by the board of directors.

Unwritten to written. The scores of new, recently-adopted corporate statements about conflicts of interest actually contain very little that is new. Indeed, most of them point out that their object is simply to repeat and make more specific the company's long-established policy on the subject—a policy which, although previously unwritten, had been in existence and universally understood and obeyed from time immemorial.

Nevertheless, these policy statements do serve highly important and useful purposes. For one thing, they spell out the various conflict-of-interest situations which all employes should avoid. This is especially valuable in delineating certain grey zones, where there are no clear-cut distinctions between what is obviously right and what is patently wrong.

For instance, exactly what financial interests in concerns doing business with the company are taboo and what investments of that character are permissible?

Here is another example: is it contrary to company policy for an employe who learns about the prospects of another concern in the course of his employment to speculate in the stock of that other concern?

In the second place, these corporate policy directives, if improperly drawn, require any officer or key employe who becomes involved in a possible conflict-of-interest situation to make prompt disclosure of all the pertinent facts. Only when full disclosure is made can the company determine whether a serious conflict really exists. In many cases, the mere act of disclosure is sufficient to dispel any suspicion of impropriety. In most other cases, if the possibility of conflicting interest is revealed, appropriate steps can easily be taken to protect both the interests of the company and the reputation of the employe.

Finally, the statements of policy focus attention on the whole conflict-of-interest problem and bring to employes at all levels an awareness that their loyalty is not only expected but is duly appreciated.

Continental's policy. Before establishing its written policy, Continental Oil Company conducted a thorough study of the conflict-of-interest policies and procedures—or lack of them—of 79 prominent corporations.

The study revealed that about 79 different forms and techniques had been employed. As many as six different documents had been used in some cases, and the material put out by the various companies ranged in length from a few short paragraphs up to 15 closely printed pages. Some of these efforts were obviously too brief to do much good, while others were so wordy and tedious they very likely produced more confusion than enlightenment. Surely, there could not be that many ways of doing the job correctly!

The new Continental Oil Company policy contains what seems to be the

best features of the numerous examples studied. The final draft of the company's new policy, not yet adopted by the board of directors, is shown on these pages. It was prepared under the premise that any sound corporate pronouncement on this subject should contain the following elements:

First, a concise general statement of the company's policy;

Second, an illustrative guide to the various situations which are most likely to give rise to conflicts of interest;

Third, a requirement that each employe make full and prompt disclosure of any conflict-of-interest situation in which he may become involved; and

Lastly, a set of workable procedures for implementing the policy.

A necessary part of such implementation consists of a form questionnaire or report letter to be filled in by employes in making their disclosures. Rather detailed questionnaires are generally used when a new policy first goes into effect. Shorter, less complicated report letters should suffice thereafter. A letter of this kind is appended as "Exhibit A" to the policy statement being proposed for Continental Oil.

When a new conflict-of-interest policy goes into effect and is distributed initially, it should be accompanied by an appropriate letter of explanation from the company's chief executive officer.

Morale—a key problem. The level of morale among corporate employes will invariably be reflected in the company's annual statement of profit or loss. The success of any joint effort, whether by a football team or a corporate organization, depends in large measure upon the existence of a happy combination of mutual confidence and respect and coordinated enthusiasm.

When, therefore, a corporation adopts a policy which entails prying into the private affairs of employes, there is grave danger that their morale will be seriously impaired. This is especially true where those whose privacy is invaded are the very employes who, through long years of service, have demonstrated not only their capabilities but also their right to be trusted. These key men can be deeply offended, and thereby discour-

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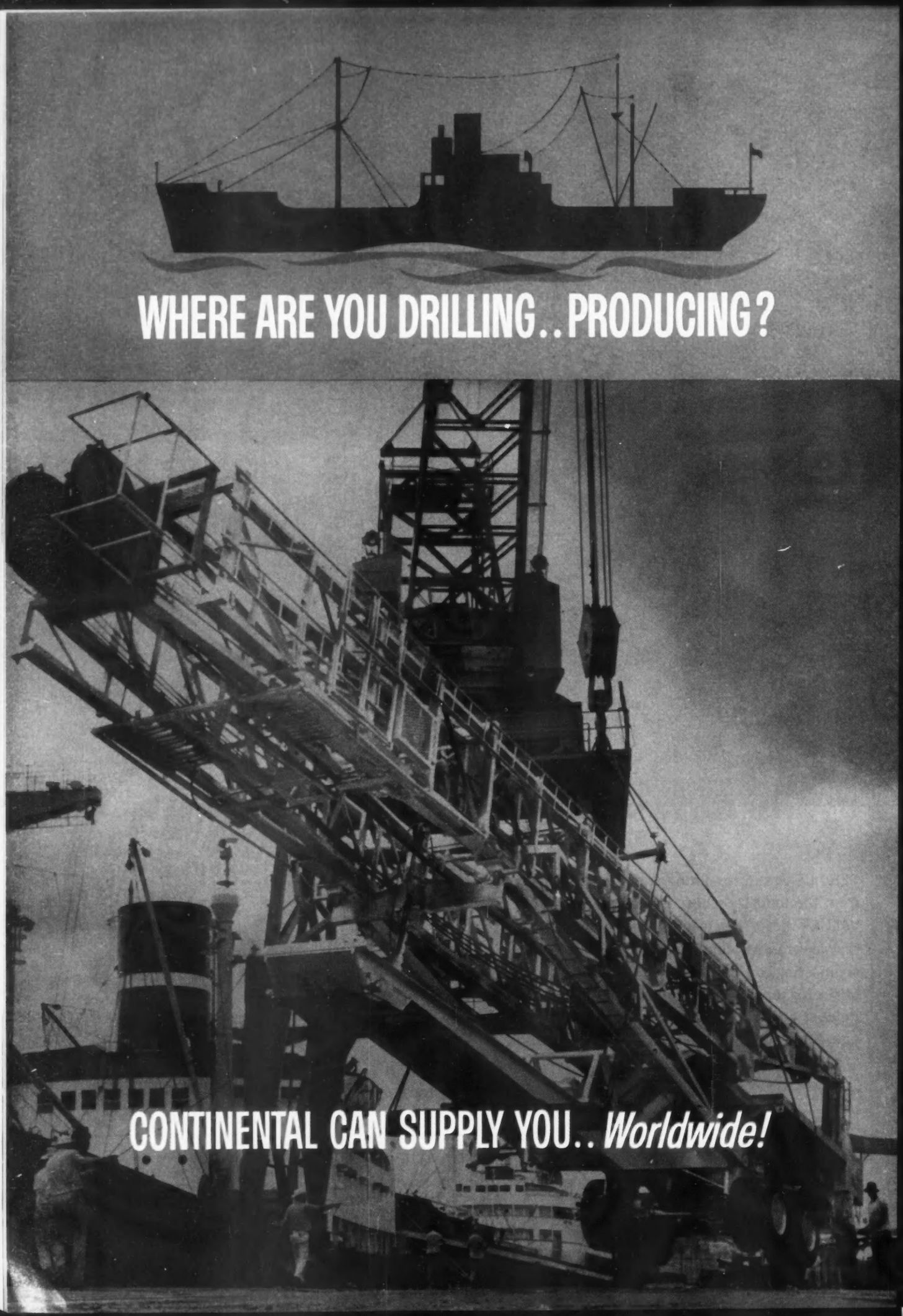
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aged, if thoughtless action is taken which seemingly impugns their loyalty. This vital aspect of the problem must be kept in mind whenever a conflict-of-interest policy is implemented.

At the same time, there must be neither a "soft" policy, nor lax enforcement of a strong one.

Among other things, careful consideration must be given to the effect of the company's policies and practices upon its relationship with suppliers, contractors and customers. This means assignment of responsibilities to a great many people down the line. Human nature being what it is, a few of those people may be tempted to place their own interests above the interests of their employer. But, if "kick backs" or other forms of "payola" should be winked at or condoned in just one or two instances, the effect will be the same as leaving one or two rotten apples in the barrel.

Every corporate employee must be mindful of his company's image in the eyes of the public. Exposure of dishonest or unlawful conduct in any large company not only visits untold harm upon that particular company, but also does injury to the whole corporate community.

ACKNOWLEDGMENT

This article is based on a speech given by Lloyd F. Thanhouser before the Corporation, Banking and Business Law Section of the American Bar Association, St. Louis, Mo., August 8, 1961.

Suggested Conflict of Interest Policy Guide for Continental Oil Company

1. Continental Oil Company's long-established policy requires that officers and all other employes avoid any situation which does or may involve a conflict between their personal interests and the interests of the Company, including its subsidiaries. Each employe has an oblibation at all times to promote the Company's best interests.

2. While it is impossible to list every circumstance giving rise to possible conflicts of interest, the following will serve as a guide to the types of activity which might cause conflicts and which should be fully reported to the Company:

(a) Ownership by an employe or any member of his immediate family living with him of a substantial financial interest in any outside concern which does business with, or is a competitor of, the Company, except where such interest consists of securities of a publicly-owned corporation and such securities are regularly traded on the open market.

(b) Rendition by an employe of directive, managerial or consultative services to any outside concern which does business with, or is a competitor of, the Company, except with the Company's knowledge and consent.

(c) Acceptance by an employe or any member of his immediate family living with him of gifts of more than token value, loans (other than from established banking or financial institutions), excessive entertainment, or other substantial favors from any outside concern which does or is seeking to do business with, or is a competitor of, the Company.

(d) Representation of the Company by an employe in any transaction in which the employe or close relative (i.e., spouse, children, parents, brothers, and sisters) has a substantial interest.

(e) Disclosure or use of confidential Company information for the personal profit or advantage of the employe or anyone else.

(f) Competition with the Company by an em-

Continued on Page 186

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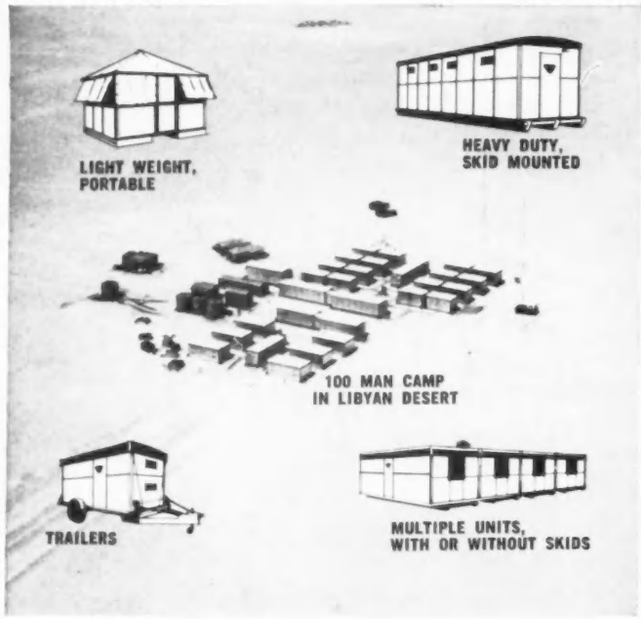
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Exhibit A

(Form of report letter called for by Policy on Conflicts of Interest)

I have reviewed and understand the Company's policy regarding conflicts of interest as set forth in the Policy Guide.

To the best of my knowledge and belief, neither I nor any member of my immediate family has any interest or connection, or has within the past year engaged in any activity, which might conflict with the Company's interest, except as indicated by check mark in one or more of the boxes below:

(a) The foregoing statement is true, without exception. ☐

(b) Except as previously reported by me in writing to the Company ☐

(c) Except as reported in full detail on a separate sheet attached to this letter. ☐

_____
(Signature)

_____
(Position)

_____
(Department, Region or Subsidiary)

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(Location)

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(Date)

ploye, directly or indirectly, in the purchase or sale of property or property rights or interest.

3. For the protection of both the Company and the employe, it is essential that the employe make prompt and full disclosure to the Company of any situation which may involve a conflict of interests.

(a) Report letters in form annexed as "Exhibit A" to this policy shall be submitted annually, prior to the end of February in each year, by all officers, headquarters department managers, regional general managers, and presidents of subsidiary companies to the Chief Executive officer. Each such person shall in turn designate the particular employes under his administrative authority who shall submit such reports and notify each such employe of his designation. The reports shall be sent to the office of the Chief Executive Officer.

(b) A report letter shall also be submitted by any employe, whether or not he is required to submit reports annually, promptly after he becomes involved in any conflict of interest situation which he has not previously reported.

(c) All information thus disclosed shall be treated on a confidential basis, except to the extent necessary for the protection of the Company's interests. —**The End**

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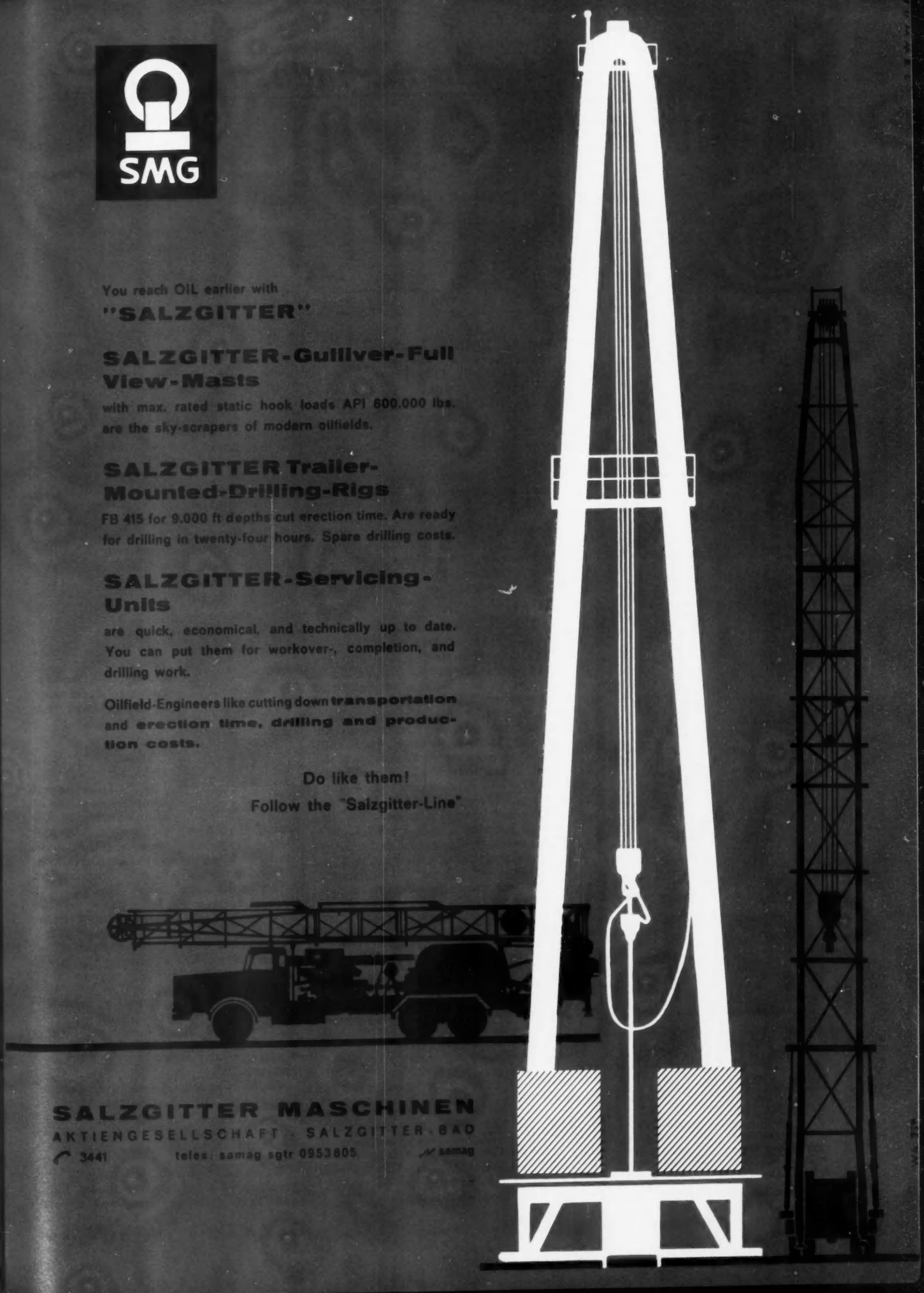

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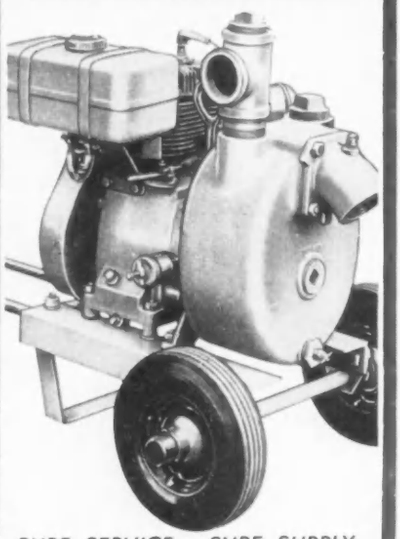

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Men in the industry

Morgan J. Davis

C. E. Reistle, Jr.

Morgan J. Davis has been named board chairman and chief executive officer of **Humble Oil & Refining Company. Carl E. Reistle, Jr.** will succeed him as president. In naming Davis to the newly created position, Humble is adopting a policy followed by numerous other companies to make the chief executive officer also the highest elective official, and relieve him of the duties carried out by the president.

F. Hugh Wilson has been named exploration manager of **Tidewater Oil Company's** foreign exploration and production division. He succeeds **Robert Dyk,** who recently resigned.

Richard A. Morse, associate director of research on oil and gas production and transportation for **Gulf Research and Development Company,** will be the 1962 president of the Society of Petroleum Engineers of AIME. New members of the SPE board of directors include **E. S. Morris,** vice president, **Amarillo Oil Company; Herman A. Engel, Jr.,** Coordinator of economics and evaluation for **Union Texas Natural Gas Corporation; John M. C. Gaffron,** assistant to the vice president of **Freeport Oil Company; Ivan Tucker,** district superintendent for **The Atlantic Refining Company; William R. Waag,** assistant vice president in the oil and gas department of the **Empire Trust Company;** and **Jimmie D. Harrington, Cawley and Harrington** consulting firm.

Lloyd A. Elkins, production research director for **Pan American Petroleum Corporation,** has been elected 1962 president of the American Institute of Mining, Metallurgical and Petroleum Engineers (AIME). **Herbert F. Beardmore,** vice president of **Gulf Oil Corporation;** and **Earl M. Kipp,** special consultant on producing problems, **Standard Oil Company of California,** have been named vice presidents of AIME.

C. B. Moody, retired vice president of **The Ohio Oil Company** and past president of the American Association of Petroleum Geologists, has been named board chairman of **Buttes Gas and Oil Company. Jeff Watts,** previously general manager, becomes president.

F. L. Newby has been appointed manager of natural gas utilization for **Standard Oil Company of California.** He previously was a vice president of California Sales Company, a subsidiary of California Standard.

Frederick W. Atherton will join **Continental Oil Company** about November 1. He will be chiefly concerned with analytical appraisal of company operations and projects, from the point of veiw of shareholders, and company relations with the investment community. Atherton is expected to be elected a vice president upon joining Conoco.

D. F. Godfrey, president of Signal Oil and Gas Company, has been transferred to the parent Standard Oil Company of California as a member of corporation management in association with G. J. O'Brien, vice president for governmental relations. He is succeeded as Signal's president by **A. E. Stevens,** previously assistant general manager-wholesale, in western operation's marketing department. In other top management changes, **R. W. Heath** has been named executive vice president, and **Harold F. Clary,** senior vice president.

Gilbert H. Lapiere, formerly in the economics department Cities Service Petroleum Company, has been elected a vice president and manager of the petroleum department of **Union Bank, Los Angeles.**

G. H. Lapiere

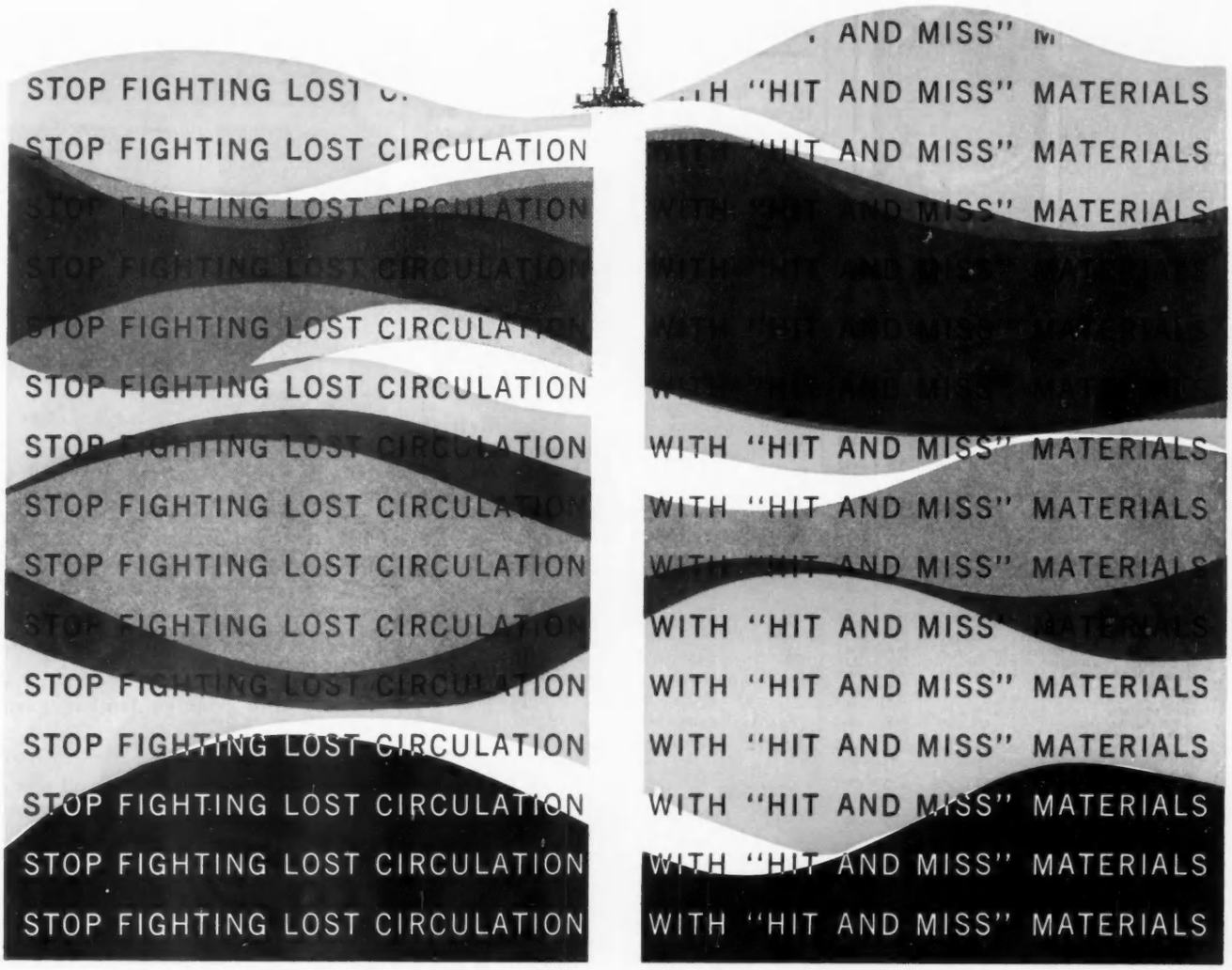
Howard J. Van Dyke, editor of "The Link," Tulsa-based company magazine of **Humble Oil & Refining Company's** central region and Jersey Production Research, and **William A. Keenan,** an assistant editor, have been transferred to Humble's headquarters office in Houston.

Donald A. Hamilton, assistant treasurer of **Cities Service Gas Company,** has been elected to the board of directors of **Cities Service Gas Producing Company,** a subsidiary.

Daniel Schusterman, head of **Schusterman Oil Company,** is opening an office in Denver to direct operations in the Denver-Julesburg and Powder River basins.

G. T. Thomas, district geologist for **The Ohio Oil Company** at Jackson, Miss., has been appointed senior geologist on the staff of Chief Geologist Glen B. Gariepy, in Tulsa.

Ralph B. Gilpatrick, Jr., formerly vice president of the **Mellon National Bank and Trust Company's** national depart-



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Men in the industry

ment, has been elected to the board of directors of the **South Penn Oil Company,** Oil City, Pennsylvania. In other changes, **Thomas O'D. Murray,** member of the board of directors and executives committee, has been named chairman of the executive committee replacing **George J. Hanks** who has retired; and **R. W. Grunert,** senior vice president and member of the board, has been appointed to the executive committee to replace **H. William Loveland,** retired.

Graham W. Garton has been appointed to the newly created post of government representative for **British American Oil Company,** with headquarters in Ottawa. He will be the company's general executive representative in the capital as well as maintaining specialized marketing relations with government departments and agencies and foreign legations.

Milton C. Lewis, Tulsa, has been named assistant general sales manager (merchandising) in **Texaco's** New York general office. **George W. Johnson** replaces Lewis as manager of liquefied natural gas sales in Tulsa.

Norton R. Perry, geologist at Pittsburgh, Penn., for **Mobil Oil Company,** has been transferred to the Oklahoma City office.

John N. Schuelke, oil and gas industry consultant, has been named manager of the industrial development department at Bank of the Southwest, Houston.

John N. Schuelke

W. V. Coffey

W. V. Coffey has been promoted to the newly created position of senior vice president and treasurer of **Ambassador Oil Corporation.** He has been vice president, treasurer and a director of the company since its formation Jan. 1, 1956.

Keith F. Walker, Ardmore, Oklahoma geologist, has opened an office at Oberlin, Kansas, with **Robert C. Lewellyn,** formerly with **Sauvage Drilling Company,** in charge.

C. J. Schertzer, independent oil operator at Bartlesville, Okla., has been named chairman of the oil and gas committee of the **Bartlesville Chamber of Commerce.**

D. V. Crowley has been named district drilling engineer in **Gulf Oil Corporation's** Houston production district. He succeeds **J. O. Crowe** who was transferred to the Gulf technical services group. Crowley recently returned from Bolivia where he directed drilling for a subsidiary, **Bolivian Gulf Oil Company.**

Stuart K. Clark, geologist with **Continental Oil Company** for 38 years, has retired. He has lived in Houston since 1949, serving as consultant in the international exploration and production department.

J. D. Wyatt, drilling superintendent for **Edmand Drilling Company,** has been promoted to vice president and general manager of the Houston-based firm. **J. S. Ashworth,** who previously owned and operated the **Ashworth Well Service** at Bay City, Texas, has been named to succeed Wyatt as drilling superintendent.

George R. Bixler, president of **American Association of Petroleum Landmen,** has joined **Vaughn Petroleum Company,** Dallas, as manager of lands. He formerly was with **BBM Drilling Company,** Houston.

Harris Houston has joined **Cardinal Petroleum Corporation** as West Texas crude oil representative, with headquar-

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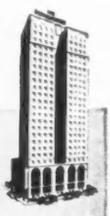

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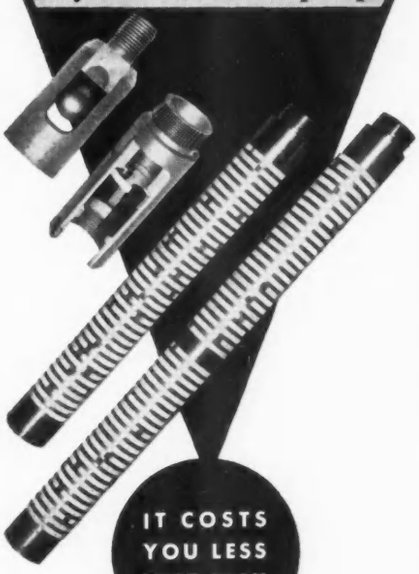

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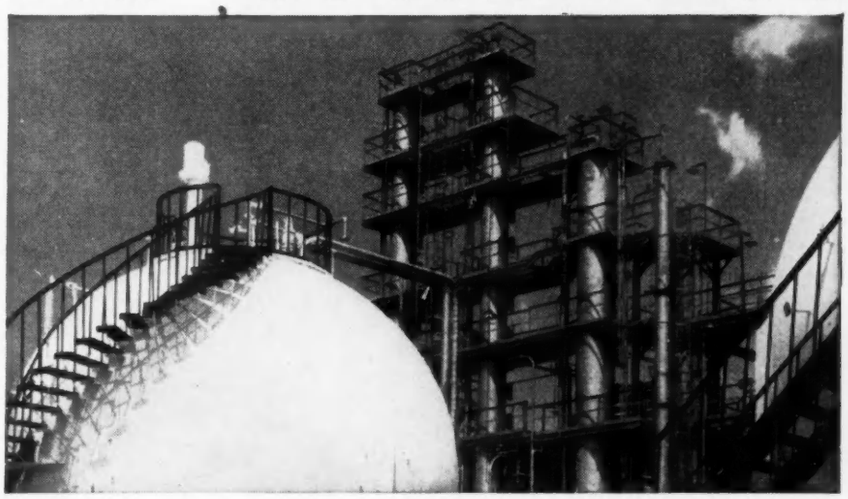

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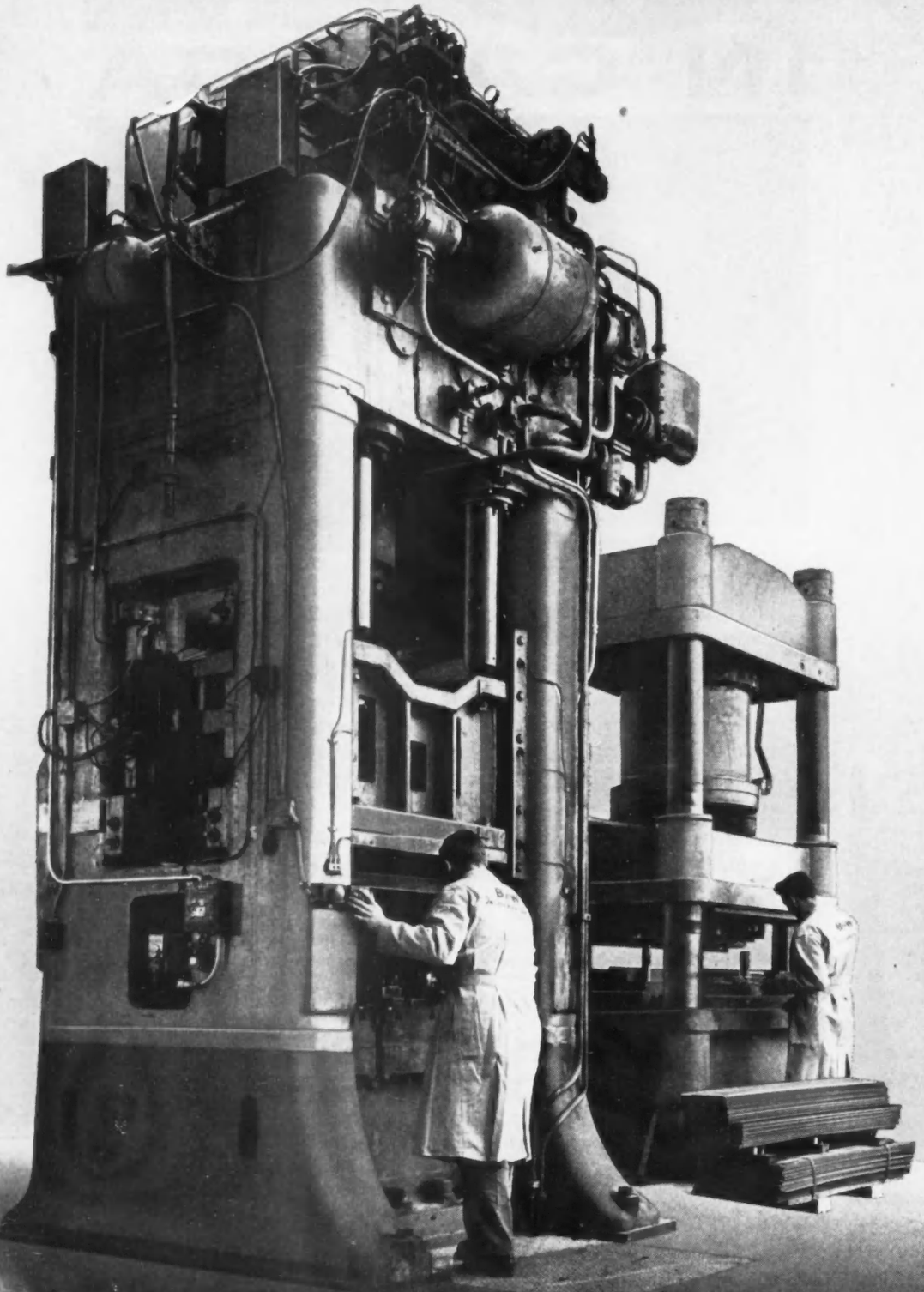

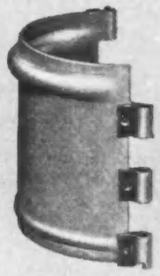

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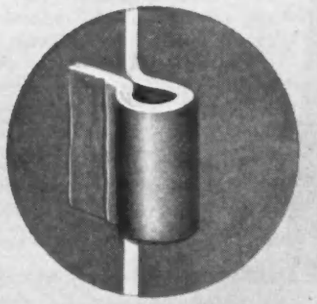

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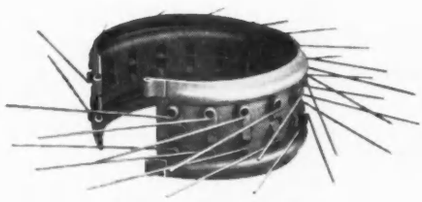

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Men in the industry

ters in Midland, Texas. He formerly was with **Crown Petroleum Corporation.**

Lee J. Thronson, formerly vice president in charge of operations for **Oil and Gas Property Management, Inc.** and **Naf-Co Oil and Gas, Inc.,** Dallas, has announced the organization of **Parva Petroleum Company,** a new oil and gas property management company with headquarters in Corpus Christi, Texas.

L. J. Thronson

H. H. Beeson

Henry H. Beeson will head a newly established natural gas section of **Mobil Oil Company's** Exploration and Producing department in New York. In other changes, **James R. January,** formerly natural gas manager for the Denver exploration and producing division, will hold the newly created position of market development manager, and **C. R. Yarbrough** will move from New York to Denver as division gas manager.

Hal P. Kibbey and **James E. Nielson** have been appointed to the executive committee of **Canadian Husky Oil Ltd. and Husky Oil Company. Richard M. Anderson** has joined Husky Oil Ltd. as secretary and staff assistant to the president. He formerly was an executive secretary on the personal staff of Howard Hughes, president of Hughes Tool Company.

Howard Halff has been named assistant superintendent of gas and gasoline plants for **Texaco Inc.,** Houston division, domestic producing department.

John F. Jones, a senior attorney for **Pan American Petroleum Corporation,** Tulsa, has joined the law department of **Standard Oil Company (Indiana),** Chicago.

Ernest R. Fleck, Jansonious, Fleck and Associates, Bismarck, N. D., has been elected president of the **North Dakota Oil and Gas Association. William S. Murray, Cox, Pearce and Engebretson,** Bismarck, has been elected secretary, and **E. D. Saltzman, First National Bank,** Bismarck, treasurer. Vice presidents include **D. F. McMahon,** Bismarck independent operator; **Bruce P. Alfson,** Williston independent operator; **Willard**

Men in the industry

A. Burton, California Oil Company, Bismarck; **C. A. Dawson, Skelly Oil Company,** Bismarck.

F. T. Connolly has been named chief geologist in the **Shell Development Company's** Houston area exploration department. He previously was manager of the geological department in **Shell Development Company's** Houston exploration and production research divisions. **B. J. Ferris,** senior geologist, will replace Connolly.

Willard G. Wiegel has joined **Byrd Enterprises,** Dallas, where he will be executive assistant to **D. H. Byrd** in management of the company which has oil and gas operations and other interests. Recently retired vice president of Lone Star Gas Company, Wiegel also has been named executive vice president of **Dallas Trust Company,** and vice president of **Sabine Supply Company.**

J. V. Threadgill, superintendent for **Stekoll Petroleum Company,** has been transferred from Snyder to Borger, Texas.

R. L. Sedway, production engineer for **Union Texas Natural Gas Corporation** in Midland, Texas, has been transferred to Oklahoma City as reservoir engineer.

Sinclair Oil and Gas Company combined its Houston and New Orleans Divisions September 1, with the following personnel changes:

O. G. Simpson

O. G. Simpson, assistant division manager at New Orleans, will become assistant manager of the Houston division.

J. T. Ray, division exploration superintendent, will become distirct manager at Jackson, Mississippi, succeeding **G. O. Davis,** who will be transferred to the Denver, Colorado division.

J. M. Clevenger, division production superintendent, will become production superintendent for Sinclair Canada Oil Company at Calgary, Alberta, Canada.

C. C. Barber, division geologist, will become assistant division geologist at Houston; **J. C. Knight,** division geophysicist, will become staff geophysicist at Houston; and **B. R. Roark,** division production engineer, will transfer to Denver.

Joseph S. Badyk has been assigned to head the newly formed natural gas and crude oil supply department for **Canada-Cities Service Petroleum Corporation** at Calgary, Alberta, Canada. He previously was assistant secretary and treasurer of the company.

Richard P. Hill has been elected president of **MidSouth Gas Company.** He succeeds **Carl E. Cloud,** who resigned to become president of **Michigan Gas Utilities Company.**

Leroy Gideon, formerly geologist and production superintendent for Rowan Drilling Company, has announced the organization of **Gideon Oil Company,** Fort Worth, Texas. The firm will function as an exploration and producing company.

Roger Swenson, newly appointed assistant treasurer of **Union Texas Natural Gas Corporation,** will transfer from Houston, to Tulsa.

Paul J. Wolfe has been advanced to the newly created position of planning manager in **Mobil International Oil Company's** New York offices.

Geologist **George L. Roller** has joined Houston independent operators **Van Dyke & Mejlaender** as a specialist in geology of Southeast Louisiana.

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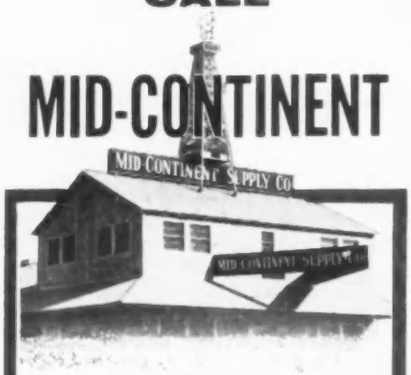

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Who's Meeting Where

OCTOBER

AGA, 43rd annual convention, Statler Hilton Hotel and Municipal Auditorium, Dallas, Oct. 1-4.

Ninth annual Gas Measurement Institute, University of Kansas, National Guard Armory, Liberal, Kan., Oct. 3-4.

AAODC, 21st annual meeting, Rice Hotel, Houston, Oct. 4-6.

ASME, Process Industries Conference, Shamrock-Hilton Hotel, Houston, Oct. 4-6.

NACE, Western Regional Conference, Benson Hotel, Portland, Ore., Oct. 4-6.

SPE of AIME, 36th annual fall meeting, Memorial Auditorium Dallas, Oct., 8-11.

NACE, North Central Regional Conference, Chase Park Plaza Hotel, St. Louis, Oct. 9-11.

National Association of Oil Equipment Jobbers, 11th annual convention and trade show, Mayflower Hotel, Washington, D. C., Oct. 15-17.

Rocky Mountain Oil & Gas Association, 16th annual convention, Denver-Hilton Hotel, Denver, Oct. 18-20.

AAPG, Mid-Continent regional meeting, Amarillo, Texas, Oct. 18-21.

AIME, Metallurgical Society fall meeting, Pick Fort Shelby Hotel, Detroit, Oct. 23-26.

ASM, Metal Show, Cobo Hall, Detroit, Oct. 23-27.

NACE, South Central region conference and exhibition, Shamrock-Hilton Hotel, Houston, Oct. 24-27.

AAPG, Gulf Coast Association of Geological Societies 11th annual meeting, Granada Hotel, San Antonio, Texas, Oct. 25-27.

IPAA, annual meeting, Shamrock-Hilton Hotel, Houston, Oct. 29-31.

NOVEMBER

AAPG, Southwestern Federation of Geological Societies, 4th annual meeting, Hilton Hotel, El Paso, Texas, Nov. 1-3.

SPE of AIME, 32nd annual California regional meeting, Hacienda Motel, Bakersfield, Calif., Nov. 2-3.

Geological Society of America, annual meeting, Cincinnati, Nov. 2-4.

SEG, annual meeting, Denver, Nov. 5-9.

AAPG Pacific Section regional meeting, Los Angeles, Nov. 9-10.

API, 41st annual meeting, Conrad Hilton Hotel, Chicago, Nov. 13-15.

API, Board of Directors meeting, Conrad Hilton Hotel, Chicago, Nov. 15.

Mineral and Tidelands Law Institute, Sixth Annual Meeting, Tulane University, New Orleans, Nov. 17.

ASME, winter annual meeting, Statler-Hilton Hotel, New York City, Nov. 26-Dec. 1.

NACE, Southeast region conference, Key Biscayne Hotel, Miami, Nov. 27-Dec. 1.

DECEMBER

AIME SPE, Arizona section annual meeting, Pioneer Hotel, Tucson, Dec. 4.

IOCC, annual meeting, Denver-Hilton Hotel, Denver, Dec. 4-6.

1962

JANUARY

Kansas Oil Men's Association, annual meeting, Broadview Hotel, Wichita, Kansas, Jan. 21-23.

FEBRUARY

Southwestern Legal Foundation, 13th annual institute on the law of oil, gas and taxation, Southwestern Legal Center, Dallas, Feb. 14-16.

AIME, annual meeting, New York City, Feb. 18-22.

AAPG, Rocky Mountain section, 12th annual meeting, Salt Lake City, Utah, Feb. 26-28.

International Oil & Gas Educational Center, institute on economics of the gas industry, Southwestern Legal Center, Dallas, Feb. 27-Mar. 2.

API, Division of Production, Southern District meeting, Rice Hotel, Houston, Feb. 28-Mar. 2.

MARCH

API, Division of Production, Southwestern District meeting, Lincoln Hotel, Odessa, Texas, Mar. 21-23.

New England Gas Association, annual meeting, Statler-Hilton Hotel, Boston, Mar. 21-23.

AAPG, annual meeting jointly with AAPG-SEPM-SEG Pacific sections, Fairmont Hotel, San Francisco, Mar. 26-29.

APRIL

API, Division of Production, Mid-Continent District meeting, Sheraton-Oklahoma Hotel, Oklahoma City, Apr. 4-6.

Mid-West Gas Association, annual meeting, Hotel Radisson, Minneapolis, Apr. 9-11.

API, Division of Production, Rocky Mountain District, Denver Hilton Hotel, Denver, Apr. 11-13.

ASME, Oil & Gas Power Division Conference, Shoreham Hotel, Washington, D. C., Apr. 15-18.

International Oil & Gas Educational Center, institute on public affairs and public relations in the oil industry, Southwestern Legal Center, Dallas, Apr. 19-20.

AAPG, Rocky Mountain section, 12th annual meeting, Salt Lake City, Utah, Apr. 23-25.

IPAA, mid-year meeting, Hotel Muehlebach, Kansas City, Mo., Apr. 29-May 1.

AGA, Operating Section, transmission conference, combined with Southern Gas Association annual convention, Houston, Apr. 30-May 2.

MAY

AIME, 5th biennial secondary recovery symposium, Wichita Falls, Texas, May 7-8.

API, Accident Prevention and Fire Protection Committees meeting, Denver Hilton Hotel, Denver, May 7-11.

AIME, Rock Mountain petroleum sections, 8th annual joint meeting, Billings, Mont., May 24-25.

JUNE

AGA, Operating Section, production conference, Statler Hotel, Boston, June 4-5.

API, Division of Production, mid-year committee conference, Jung Hotel, New Orleans; June 10-15.

Canadian Gas Association, annual meeting, Manoir Richelieu, Murray Bay, Quebec, Canada, June 20-23.

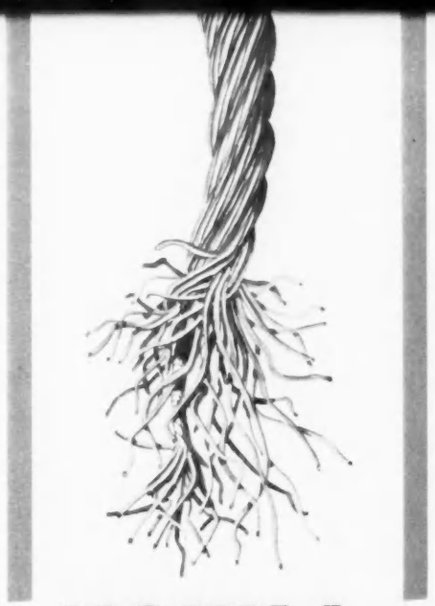
Michigan Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich., June 25-26.

OCTOBER

AIME-SPE, fall meeting, Los Angeles, Calif., Oct. 7-10.

IPAA, annual meeting, Statler-Hilton Hotel, Dallas, Oct. 28-30.

NOWSCO Nitrogen cuts completion cost — Job #1712



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No need for swabbing when NOWSCO brings your well in.

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- Eliminated possible swab loss
- No chance of blowout

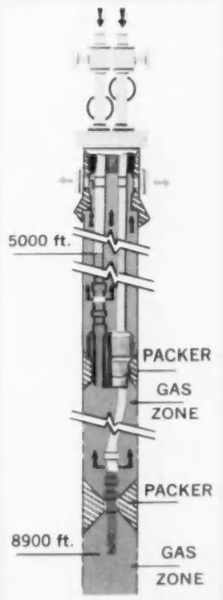
Nitrogen techniques by NOWSCO save money in many other ways — increase penetration of hydraulic perforating, provide inert gas bubbles to push frac fluids and spent acids out of formation, quickly lighten mud column to combat lost circulation, test pressure-tightness more sensitively than with fluid, prevent downhole explosions when gas drilling through pay formations.

NOWSCO Nitrogen comes to your site night or day, in self-contained transport-pump trucks. NOWSCO servicemen are veteran oil field workers thoroughly trained in nitrogen techniques. Backed by more than 1700 cost-saving NOWSCO jobs, they're ready to service your wells with individually calculated injection rates, pressures, volumes.

Want the NOWSCO story on your field conditions? Write or call today for on-the-job case histories.

NOWSCO offers the only complete liquid nitrogen service . . . from manufacture through field application.

NOWSCO service trucks and operators are on 24-hour ready at Houston, Corpus Christi, Perrytown, Odessa, Orange and Lafayette, La.

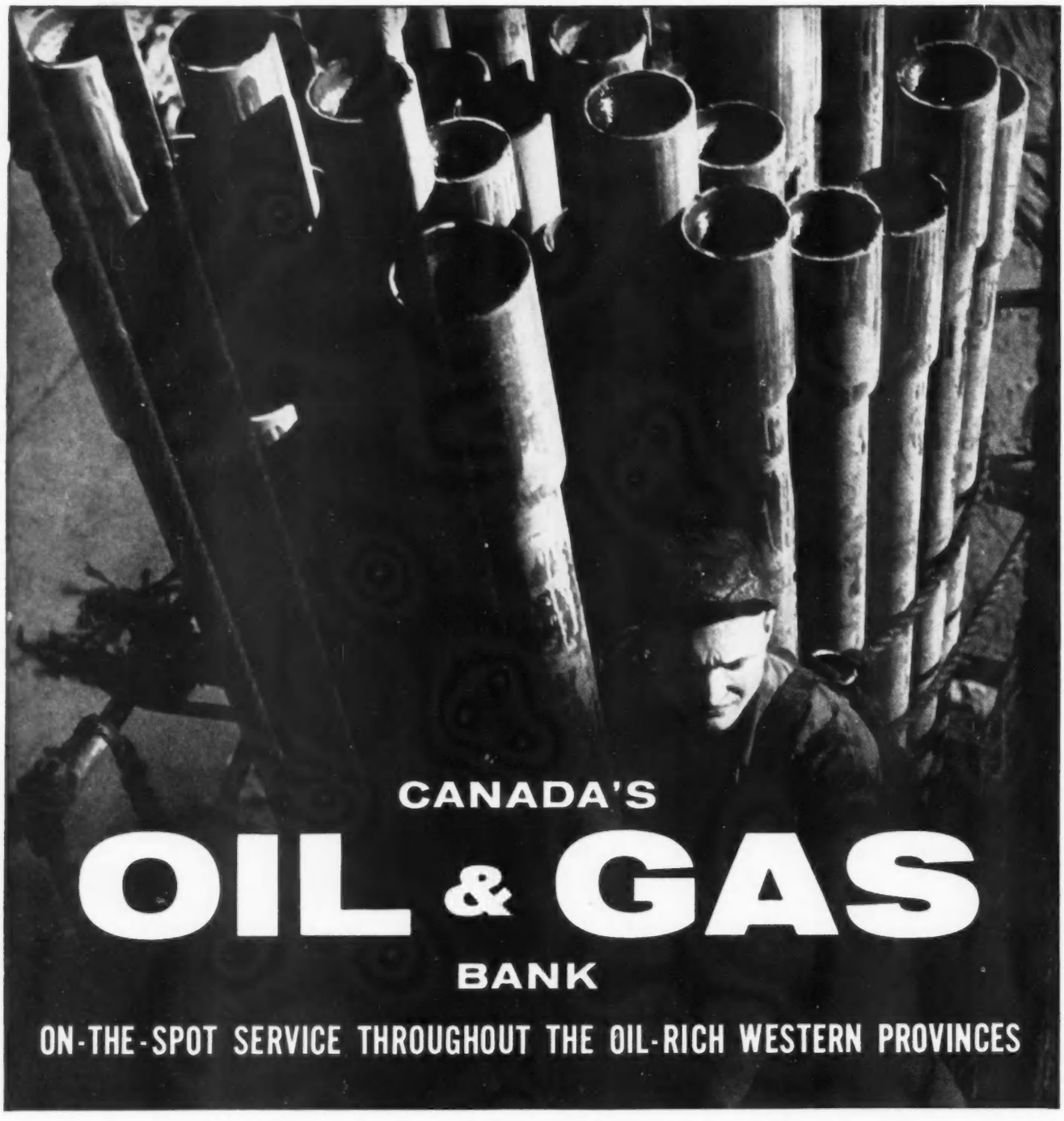


NOWSCO Nitrogen displaced all of lower string and 5000 ft. of upper string, as shown. Both were brought in by bleeding Nitrogen to atmosphere.

Originator and prime authority on liquid nitrogen techniques . . .

NOWSCO N_2

NITROGEN OIL WELL SERVICE COMPANY
3602 West 11th Street, Houston, Texas
Telephone: UN 4-0965



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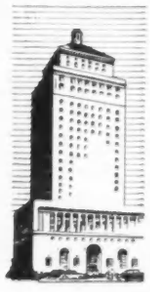

A list of current Oil and Gas bulletins covering regulations, tariffs, financing, statistics and kindred subjects pertaining to the Canadian industry is available on request. Write to Mr. T. C. Marshall, Room 1523, 300 North Ervay St., Dallas 1, Texas; or to The Royal Bank of Canada, Oil and Gas Dept., 409 Eighth Avenue West, Calgary, Alberta.

We do not provide information on oil securities.

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Associations

New Houston Desk and Derrick Club officers are (standing, left to right): Margaret Frommel, Duse Branch, Bobbie Clinkenbeard, Edwina Reddick, Virginia Renick, Ramelle Trimble and Margaret Weyer; (seated, left to right): Elizabeth Quick, Claire See, Earlene Monroe, Eleanor Wirfel, Ann Fontenot, Gladys Jurchak and Myrtle Heise.

Eleanor Wirfel Is Houston Desk & Derrick President

Miss Eleanor Wirfel, secretary to Fred J. Heyne, Jr., of King & Heyne, has been named president of the Desk & Derrick Club of Houston for 1961-62.

Other officers elected for the fiscal year beginning October 1, are: Mrs. Earlene Monroe of Butler, Miller & Lents, 1st Vice President; Mrs. Ann A. Fontenot, Delta Tank Manufacturing Co., Inc., 2nd Vice President; Miss Gladys Jurchak, Transcontinental Gas Pipe Line Co., recording secretary; Miss Claire See, Texaco Inc., corresponding secretary, and Miss Elizabeth Quick, J. Brown Cutbirth, treasurer.

Directors elected for a two-year term were Mrs. Duse Branch, Clark Fuel Producing Co., Mrs. Bobbie Jean Clinkenbeard, Welex Co.; Miss Margaret Frommel, Western Supply Co. and Mrs. Edwina Reddick, Columbian Carbon Co.

The following directors will serve for another year: Miss Virginia M. Rennick, D. C. Chessman & Son; Miss Alberta J. Riesen, Schlumberger Well Surveying Corp.; Miss Ramelle Trimble, King & Heyne, and Miss Margaret Weyer, Baker Oil Tools, Inc.

Miss Myrtle Heise, 1960-61 president, will serve as board advisor for the coming year.

AAPG Regional Meeting Set October 18-21 in Amarillo

Some 1,000 geologists are expected in Amarillo, Texas, October 18-21 for the regional meeting of the American Association of Petroleum Geologists.

Topic of the convention is "Natural Gas on the Move—Geonomics of the Mid-Continent Area." Particular areas of discussion for the meeting will include the geologic occurrence of natural gas, the growing role helium plays in this natural resource, economics of exploration and production and the Federal Power Commission.

Geologists from Texas, Oklahoma, Arkansas, Kansas, Nebraska, Colorado and other parts of the United States will attend the four-day meeting, according to Hershel Carver, general chairman of the convention. The meeting is sponsored by the Panhandle Geological Society in cooperation with the Mid-Continent Council of Geological Societies.

Delegates will be welcomed to Amarillo, administrative center of the Texas and Oklahoma Panhandles petroleum work, by J. Ben Carsey, Vice President of AAPG.

Featured speaker will be Dr. Thomas B. Nolan, director of the United States Geological Survey.

Other highlights will be a field trip to Palo Duro State Park guided by members of the geology club of West Texas State College, ladies activities and university alumni functions.

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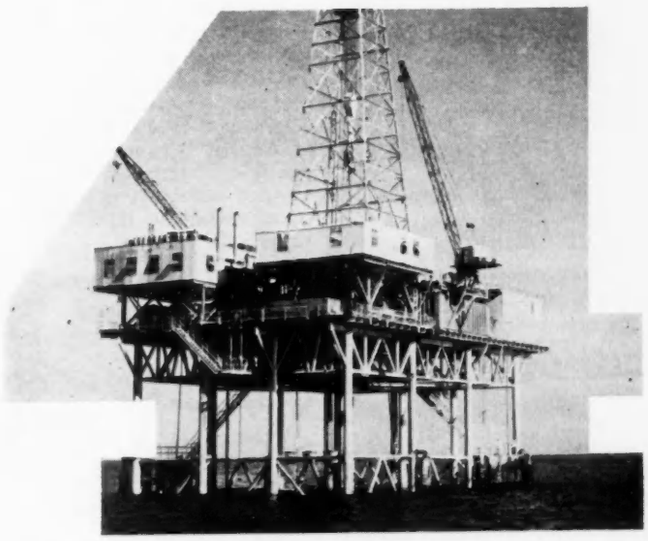

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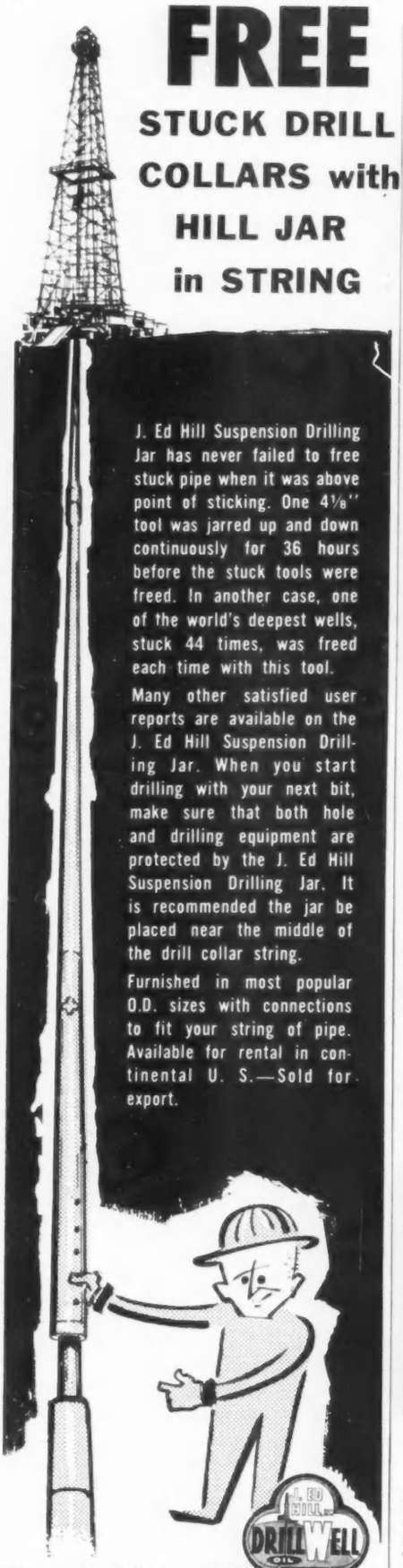

J. Ed Hill Suspension Drilling Jar has never failed to free stuck pipe when it was above point of sticking. One 4⅛" tool was jarred up and down continuously for 36 hours before the stuck tools were freed. In another case, one of the world's deepest wells, stuck 44 times, was freed each time with this tool.

Many other satisfied user reports are available on the J. Ed Hill Suspension Drilling Jar. When you start drilling with your next bit, make sure that both hole and drilling equipment are protected by the J. Ed Hill Suspension Drilling Jar. It is recommended the jar be placed near the middle of the drill collar string.

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Suppliers' notes

Royal Inspection of Magcobar Plant

One of the men attending the ceremonies at the royal inspection of the barite processing and drilling mud plant built by Sherkat Sahami Magcobar Iran is shown being presented to Shah Mohammed Reza Pahlevi of Iran. Watching in the background are S. S. Hanley, Managing Director of Dresser, A. G., a Dresser Industries foreign subsidiary; W. W. McBrien, Vice President of Magcobar's overseas operations; J. B. O'Connor, President of Dresser Industries, the parent company which planned the establishment of the Iranian facility; His Excellency the Minister of Mines and Industry, Eng. Gholam Ali Farivar; and His Imperial Majesty, the Shah of Iran. It is expected that the new Magcobar plant and barite mine would employ about 250 men and will save about $2 million a year in foreign exchange for the Iranian economy. Capacity of the new barite processing and drilling mud plant is great enough so it will be able to also furnish drilling fluids to other countries of the Middle East.

B. C. McKnight has been moved to the Dallas office of **Daniel Orifice Fitting Company** as district sales representative. McKnight will serve customers in the northeast Texas area.

B. C. McKnight

R. E. Foshee, Jr.

Roland E. Foshee, Jr., is the new manager of the Midland-Odessa branch of **Maloney-Crawford Tank and Manufacturing Co.** He is a 1951 graduate of Texas A&M.

Dr. N. A. Schuster has been named to a top-echelon research engineering post at Schlumberger Well Surveying Corp. in Houston. He will supervise all research and engineering operations.

Recent reassignments of Schlumberger field personnel include: **V. H. Maraman,** Wichita Falls, Texas, to senior sales engineer. **P. E. Spaugh,** sales engineer at Tyler, Texas, to the North Central Texas Division office in Dallas.

J. D. Matlock, former location manager at Shawnee, Okla., to Tulsa as senior sales engineer. **J. M. Price** succeeds Matlock as location manager in Shawnee.

C. R. Ferguson, sales engineer at Kimball, Neb., to Farmington, N.M.

H. W. Valentine, location manager at Williston, N. D., to division engineer and moved to Southern Rocky Mountain Division with headquarters at Denver.

M. Rex Curtis has been named sales manager for the Southern Rocky Mountain Division with headquarters at Denver. He succeeds **J. A. Mullinax** who has been promoted to assistant to the manager of the Rocky Mountain Area.

Other field personnel reassigned include **L. T. Hallman,** senior sales engineer in the Southern Rocky Mountain Division, to Kimball, Neb., as location manager.

F. W. Beazley, senior sales engineer in the Kansas Division, to McCook, Neb., as location manager.

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Suppliers' notes

W. E. Bachman, field engineer in Huntington, W. Va., sales engineer at that location. **E. C. Bevins,** senior sales engineer at Fairmont, W. Va., to Huntington, W. Va., as location manager.

Robert B. Anderson, former **Secretary** of the Treasury, has rejoined the board of directors of **Dresser Industries, Inc.**

J. B. Anderson is manager of the new supply store opened in Indianola, Neb., by **Continental-Emsco Co. George Pool,** district manager at Great Bend, Kansas, will supervise the new store.

C. M. Peters has been appointed manager of the **Oil Field Division of U.S. Industries, Inc., (Great Britain) Limited.** He was previously chief engineer, and since 1957 vice president of engineering of the Garrett Oil Tools Division.

Smith Tool Co. Observes Twenty-Fifth Year

Smith Tool Co., a division of Smith Industries International, Inc., this year is observing its twenty-fifth anniversary as a manufacturer of jet rock bits for the drilling industry. Four of the executive officers of Smith Industries shown here are (left to right): Donald E. Graham, president; H. C. Smith, chairman of the board; Arthur S. Marshall, vice president-sales, and Kenneth H. Swart, executive vice president and general manager.

George W. Henderson has joined the **Tyson Smith Company** as a sales representative. He will handle sales and service for oil and gas process equipment in the Houston area.

John Adams Thierry has been elected to the board of directors of **Bucyrus-Erie Company.** Also, **Merlin H. Birk** has been appointed a vice president of the firm.

George W. Smith, Jr., has been named general manager of the **Industrial Products Division of Westinghouse Air Brake Company** replacing **Arthur J. Bent** who resigned.

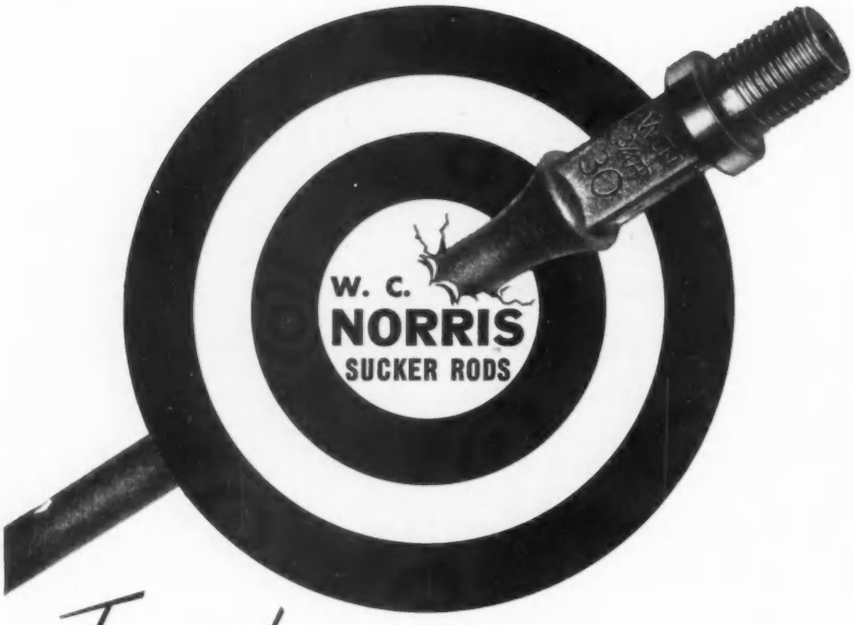
Roy H. Sjoberg has been appointed general sales manager **The White Motor Company Montpelier Division.**

William E. Toombs has been promoted to vice president of the newly organized **International Division of Technical Drilling Service, Inc.,** of Midland, Texas.

Kenneth W. Sewell, formerly sales representative for **Oil Center Tool Company** at Odessa, Texas, has been tranferred to Dallas, and **James J. Humphries,** formerly sales representative at Dallas, has transferred to Houston.

Edwin H. Howell, Jr., has been appointed superintendent of the Texas Warehouse of **U.S. Steel's Tennessee Coal & Iron Division** succeeding **M. I. Dickey** who retired.

Stanley D. Strand has been appointed manager of **U.S. Steel's Oil Well Supply Divsion** in Edmonton, Can. Also, **L. M. Roy** was named as division representative in Midland, Texas. **Robert H. Smith** has been named director-product service; **Joe L. Ward** was named store manager at Big Spring, Texas; **Daniel H. Barr,** named assistant vie president-marketing; **F. B. Mobley** named store manager, Hobbs, N.M., and **Robert E. Dickson,** Central Midwest sales manager.



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Suppliers' notes

Security Engineering Expands in Houston

Security Engineering has expanded its sales and service facilities in the Gulf Coast area with the opening of enlarged Houston offices, according to Ken Byerly, vice president-domestic sales. Shown in the new Houston office are Priscilla Nelson, secretary-receptionist; Sam R. Houston, office manager, and Frank Watts, division manager.

Reinaldo (Ray) Bibolini has been appointed manager of the newly created Foreign Operations Department of **Byron Jackson Pumps, Inc.,** a subsidiary of **Borg-Warner.** The new department will function as a centralized group at Byron Jackson sales and manufacturing headquarters in Los Angeles.

C. J. Fontaine and **B. A. (Beau) Wendt** have been appointed to top-ranking sales positions by **Reed Roller Bit Co.** Fontain has been made domestic sales manager. Wendt is assitant to the vice president of sales.

Gayle Whiddon is the new national representative, sales, for **Hughes Tool Co.** Whiddon moves to his new assignment in Houston from Dallas, where he has been regional manager since 1958.

Robert L. Kelly has been named product supervisor, automation equipment, by **Black Sivalls & Bryson, Inc. James M. Clayton** is the new branch manager at Shreveport, La.

B. G. O'Brien is manager of the new **Jones & Laughlin Supply Division** store at Hennessey, Okla. The store has been expanded into an independent full line store. The J&L store at Trenton also has been expanded into a full-line store. **J. A. Baker** is manager. Other new J&L store managers are: **O. W. Shepherd,** district store manager, Oklahoma City; **C. B. Cress,** district store manager, Wichita Falls, Texas; **F. R. DeWitt,** district store manager, Tulsa, and **A. J. Chelf,** store manager at Perry, Okla.

George E. Hall of Milwaukee has been named to the new position of manager, sales development, construction machinery division, **Allis-Chalmers Manufacturing Co.**

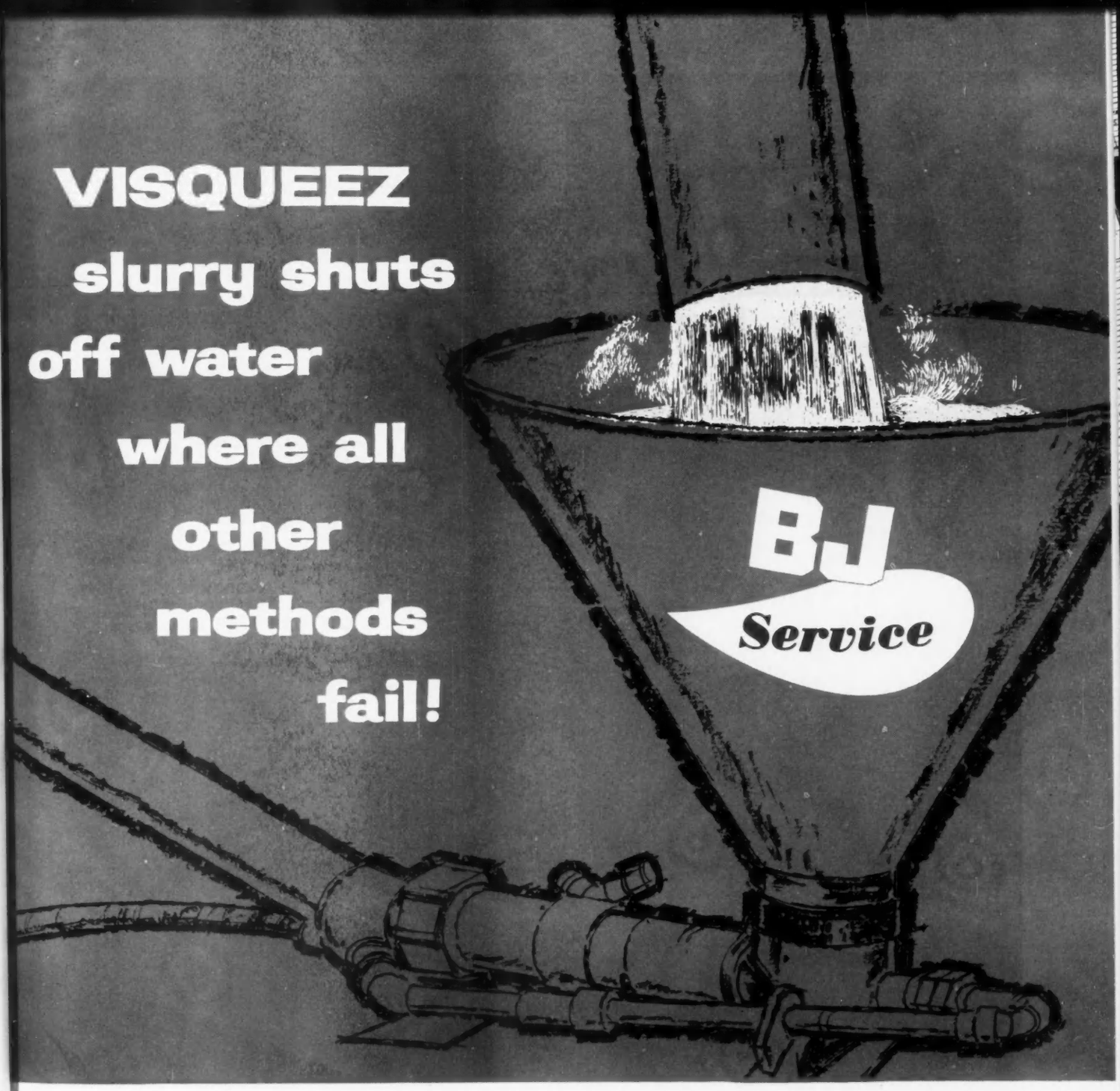
Ron Ifould has been appointed sales representative in western Europe by **The Ridge Tool International Co., Inc.**

Thomas F. Noonan and **Carra L. Lane** have been named vice presidents of **Chicago Pneumatic Tool Company.** Noonan is comptroller of the company. Lane will continue to supervise manufacturing operations of the company's domestic plants.

T. C. McCuistion has been advanced to sales manager, tubular products; **W. G. Rudd,** sales manager of rotary equipment, and **C. F. Hamm,** sales manager, general products, in a reorganization of the sales department of **The Bovaird Supply Company** in Tulsa. **Fred Gardner** will assisit McCuistion. **F. D. Moore** will be Rudd's assistant. **J. J. Harris** has been named assistant to Hamm. Completing the new organization are Harris, coordinator, sales department; **D. L. Dufford,** coordinator, purchasing and pricing, and **J. E. Goodell,** general manager of stores.

Fred L. Williams is manager of **Iverson Supply Company's** new store in Hobbs, N. M. **L. Dean Halliburton** is sales representative.

J. A. V. Watson will be appointed assistant managing director of **Castrol Industrial Limited** upon the retirement of **W. F. List** on January 1, 1962.



An exclusive BJ Service development, Visqueez is the most effective method yet devised to shut off water from producing oil or gas wells. Only Visqueez slurry *thins* on contact with water... penetrating and depositing cement deep into the most troublesome water-bearing formations. A special viscous carrying agent puts a protective coating around the cement particles. The slurry cannot set up until a *pre-timed* chemical action removes the oil coating. No high squeeze pressures... no need for reverse circulation or costly drilling out—excess slurry is recovered as free-flowing oil and cement. With BJ Service Visqueez, the well is back on production in 24 hours or less!

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Visqueez Increases Oil Production 30% — Decreases Water Production 27%

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GALVESTON, TEXAS

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Suppliers' notes

New Test Equipment

Jones & Laughlin Supply Division has installed this special test equipment at its Laurel, Miss., store to service hydraulic subsurface pumps. J&L recently was appointed distributor of hydraulic subsurface pumps manufactured by Johnson-Fagg Pump Company of Tulsa.

Thomas L. Dineen is the new manager of the Cleveland district for **Allis-Chalmers Industries Group.** The company also has announced the appointment of **Henry M. Brundage** as manager of the Chattanooga (Tennessee) District.

Wf Roberts has joined the application engineering staff of **Maloney-Crawford, Tulsa.**

Wf Roberts

R. W. Ruhe, Jr.

The promotion of **Robert W. Ruhe, Jr.,** from staff engineer to chief service engineer in the **Magnet Cove Barium Corp.** Houston office has been announced.

Frank L. Magee, chairman of the board and chief executive officer of **Aluminum Company of America,** has been named to board of directors of **Westinghouse Air Brake Company.**

David R. Davis has joined **Charles Wheatley Company** in Tulsa as coordinator of sales, advertising and pricing.

Jack Vaughan, president of **Go, Inc.,** has announced that company's acquisition of **Go Oil Well Services, Inc.,** facilities in Tyler, Texas, and Shreveport, La.

Harold E. Damron has been appointed industrial field engineer for **The Gates Rubber Co.** with headquarters in Tulsa. Other transfers include **Orville H. Moseley** to the district office in Oklahoma City and **Henry R. Berry** to industrial division field engineer in Clifton, N. J.

L. R. (Bob) French, Jr., president of **Rodman Supply Co.** of Odessa, Texas, has announced the election of four new vice presidents. **R. L. Waller** has been named executive vice president with headquarters in Odessa. **J. P. (Jake) Alexander, Jr.,** of Oklahoma City was elected vice president in charge of operations. **John J. Pickens** is the new vice president in charge of Houston and South Texas operations. **Frank B. Weber, Jr.,** moves from Dallas to Midland as vice president in charge of West Texas operations. **E. E. Kirkpatrick,** Brownwood, Texas, continues as a vice president.

J. W. (Wreno) Anderson is now design supervisor in the engineering department of **Dowell Division of The Dow Chemical Company.**

Rainey Elliott, president of **Jones & Laughlin Supply Division,** has announced four management changes. **W. L. Wolfe,** vice president-sales, moves to Houston. **R. J. Woods, Jr.,** previously director of sales, is now assistant to the president in

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Rolled threads are stronger at the point where most pin failures originate . . . steel fibers and grain are rearranged to follow the thread contour, providing a dense structure at the critical thread root. Sucker rods with rolled threads make up tighter and stay tight because there are no high spots to beat down and cause the joint to loosen.
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SUCKER RODS
142

Suppliers' notes

Tulsa. **Bill Wood,** former regional manager in Tulsa, has been promoted to the new position of general manager of sales in Tulsa. **V. H. Weldon, Jr.,** formerly assistant-manager, tubular products, is assistant to the vp-sales in Houston.

Howard R. Clark is the new Permian Basin area sales manager for Baash-Ross Division of Joy Manufacturing Company. Also, **James E. White** has been named Gulf Coast rental and service supervisor for Baash-Ross. **D. L. (Leon) Ligon** has been promoted to district sales representative in Farmington, N. M.

J. C. Bergin

J. R. Wright

W. J. McWilliams, president of Republic Supply Company, has announced the appointment of two vice presidents. New vice president in charge of operations and directing the activities of all supply districts, stores and sales offices is **J. C. Bergin. Jack R. Wright** is vice president in charge of sales. Both are located in Oklahoma City.

Kenneth S. Adamson is now application engineer, specializing in regulators, for **Grove Valve and Regulator Company.** His headquarters are in Los Angeles.

Claude R. Whelchell has joined **Security Engineering** as a special sales representative in the Gulf Coast Division.

W. M. Klett has been named a territory manager of the Southwest region for **International Harvester's** construction equipment division.

John S. Rhodes

S. H. Hasan

Colin Waters has been appointed general manager and **John S. Rhodes** assistant general manager of **Castrol Limited** in south and east Asia. **S. H. Hasan** becomes general manager in Pakistan. Waters joined Castrol 14 years ago as a clerk in the Overseas Division in London. Rhodes has been with the company since 1937 and is a former general manager for Pakistan. Hasan joined Castrol as a salesman in Karachi in 1950.

Colin Waters

Z. C. Ambrose has been named general sales manager of **Bowen Itco, Inc. Fred N. Osmun,** president of the fishing and specialty tool manufacturing firm, made the announcement in Houston. Ambrose will direct all sales activities of the company's 21 domestic sales outlets along with export sales through the Free World. Ambrose has more than 25 years' experience as an engineer and executive in the oil industry.

Z. C. Ambrose

Guy W. Gant is the new Northern Regional Manager and Product Sales Department Manager for **Otis Engineering Corporation** of Dallas. He will headquarter in Otis' Dallas office.

Have you ever considered the risk you're taking if the burner units on your leases provide less than 100% protection against flashback fires? Each year lease equipment worth thousands of dollars is destroyed because of faulty or inadequately protected burners.

The best way to eliminate fire control problems is to specify ENARDO Burners with Flame Arrestors for your gas-fired line heaters, oil treaters and dehydration heaters. Both the in-line and angle models feature an arrestor cell of aluminum alloy wound in a tight "honycomb" arrangement to prevent flashbacks. The cells are easily removable to permit cleaning and periodical checking at the installation.

With ENARDO Burner Assemblies, you can also forget about freeze-ups in cold weather—both the burner and pilot orifices are inside the housing. Control valves are outside for easy access and an outside door permits primary and pilot adjustment. The complete unit, available in capacities from 45,000 to 6,000,000 BTU/HR, is readily adaptable to your vessel.

Don't take chances with your lease equipment—insist on dependable ENARDO Burners with Flame Arrestors.

PREVENT FLASHBACKS

SPECIFY ENARDO BURNERS WITH FLAME ARRESTOR CELLS

Call , write or wire Enardo Manufacturing Co. for further information..

ENARDO manufacturing co.

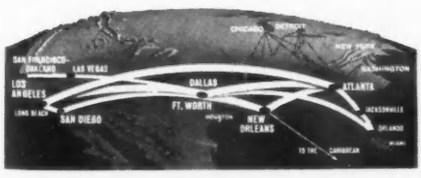
BOX 1647 • TULSA, OKLAHOMA

The Key Cities of the South are on DELTA'S new trans-continental Skyway

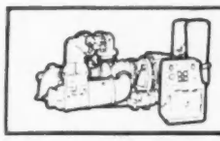
Delta's big jets over a new Southern Transcontinental Route now enable you to include important cities across the South on a coast-to-coast trip. Los Angeles, Dallas, Fort Worth, New Orleans and Atlanta all lie along Delta's new jet skyway. Plus DC-7's between San Diego/Las Vegas and the Southeast. And October 15th, Delta inaugurates service to San Francisco.

DELTA

A New Southern Transcontinental Route



...just part of routine in the flow of Ruston TA Gas Turbine production, but it's worth noting that *over one hundred* TA's have already been dispatched from our works... and they all receive the same meticulous attention throughout production and individual test. It is also significant that of the continuous-service industrial gas turbines in the 1000/2000 b.h.p. bracket, easily the greatest number now operating throughout the world are Ruston TA's.



RUSTON

'TA' GAS TURBINES

The lightweight, long-life power units which give the oilman 1260 b.h.p. at the push of a button - and regularly over 10,000 hours between inspections.

RUSTON & HORNSBY LIMITED · LINCOLN · ENGLAND

Associated with Davey, Paxman & Co., Ltd., Colchester

TAP. 1

For more data on advertised products, use cards, last page.

LOWER LIFTING COSTS

In Both Primary and Secondary Recovery, You Can Depend on

THOMPSON ROD PUMPS

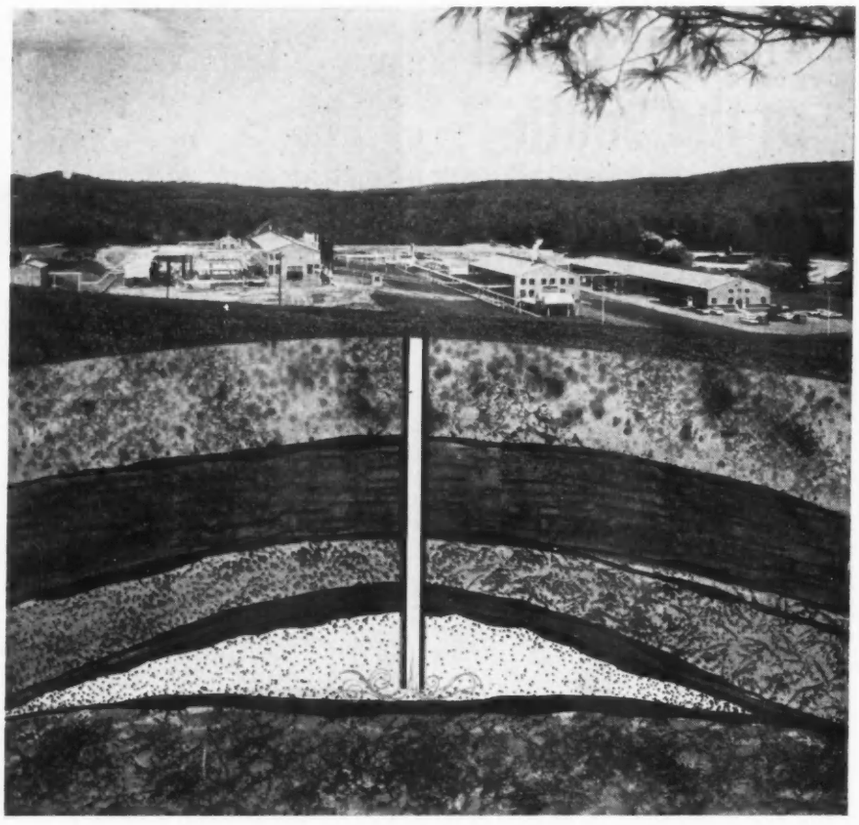
Solve down-hole pump problems by standardizing on Thompson Rod Pumps—they run longer, more economically. You can count on reliable performance!

OVERSIZE PUMPS:
1 5/8" Bore for 2" Tubing,
2 1/8" Bore for 2 1/2" Tubing.

STANDARD:
1 1/16" 1 3/4"
1 1/4" 2"
1 1/2" 2 1/2"

Thompson
PUMP COMPANY

DRAWER 591 • OKMULGEE, OKLA.



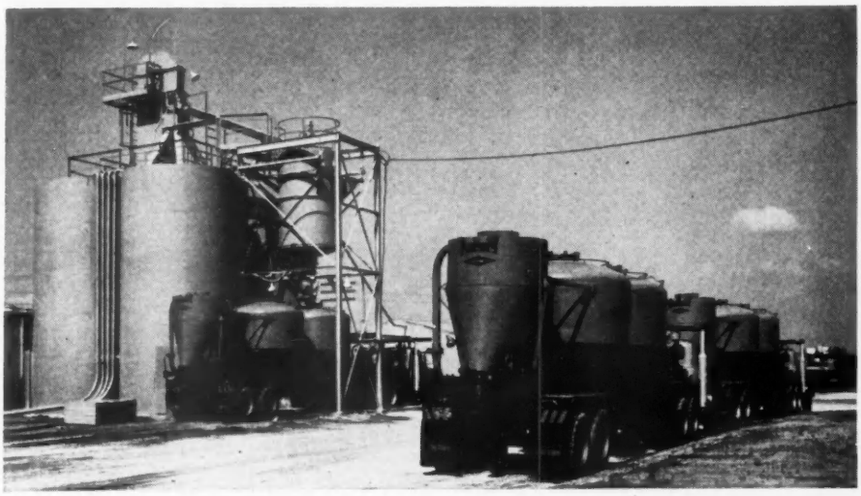
How Transco takes up the Slack Between Gas Supply & Consumption

Storing natural gas underground in depleted gas producing areas of Pennsylvania is an important part of Transco's business. The company's customers have large space heating loads in the winter which would be costly to serve if pipe line facilities had to be built between Texas and New York just for this purpose. Instead, Transco has developed for its customers a sort of "Christmas Club" whereby the customers authorize the company to store gas for their accounts in the low load periods of summer, delivering this gas in winter over short lines from the storage fields which are close to the metropolitan market area. Thus, while purchasing gas on a year-round basis, Transco, through underground storage, takes up the slack between supply and ultimate consumption of natural gas, effecting operational economies for both producers and marketers.

TRANSCONTINENTAL GAS PIPE LINE CORPORATION

CARRYING NATURAL GAS FROM TEXAS AND LOUISIANA TO THE MARKETS WHERE THE MOST PEOPLE ARE.

Suppliers' notes



Bulk cement transports being loaded from storage tanks at Dowell's new oil well cementing station in Lafayette, La.

Dowell Division Opens New Cementing Station

The opening of new cementing stations at Lafayette, La., McComb, Miss., and Hattiesburg, Miss., has been announced by Dowell Division of the The Dow Chemical Company.

Dowell recently opened its oil well cementing activities on the Gulf Coast. To serve the area, the company developed a new two-pump, heavy duty cementing unit. The Louisiana-Mississippi area is also served by a cementing station at Houma, La. J. B. Stewart is manager of the area activities.

Henschel-Werke Opens Branch in Teheran, Iran

Henschel-Export GmbH, Frankfurt, and Henschel-Werke GmbH of Kassel, West Germany, have jointly announced the opening of its own office in Teheran, Iran.

Headed by Guido von Swieykowski-Trzaska, the Henschel-Iran office will be responsible for the expansion of business in Iran and the Near East.

Eastman Completes Tests On Directional Turbodrill

Eastman Oil Well Survey Company, Denver, has completed a successful run of a directional turbodrill in the United States. Based on the experience of its subsidiary in Germany, and extensive research, Eastman has developed a technique for using the turbodrill controlled by a specially designed deflection method.

The field tests are part of an evaluation program by Eastman to determine the economics of using the turbodrill for directional drilling as applied to domestic drilling conditions. The test was conducted in connection with a planned directional program on a well in Texas. The total dogleg of 3¾° was equally distributed over the entire run of 40 feet. The tool was oriented by conventional methods.

WORLD OIL'S Trading Post CLASSIFIED ADVERTISING

RATES: Regular Classified (undisplayed) set in this size type 20 cents per word. Minimum charge $4. Blind box address in our care counts six words. Replies forwarded without charge. Display Classified ads, set in suitably larger type with ruled border, $13.50 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. All Classified ads payable in advance. Copy deadline: Twelfth of month preceeding date of issue. Send copy and checks to: Trading Post Classified Section, World Oil, P. O. Box 2608, Houston 1, Texas

SITUATIONS WANTED

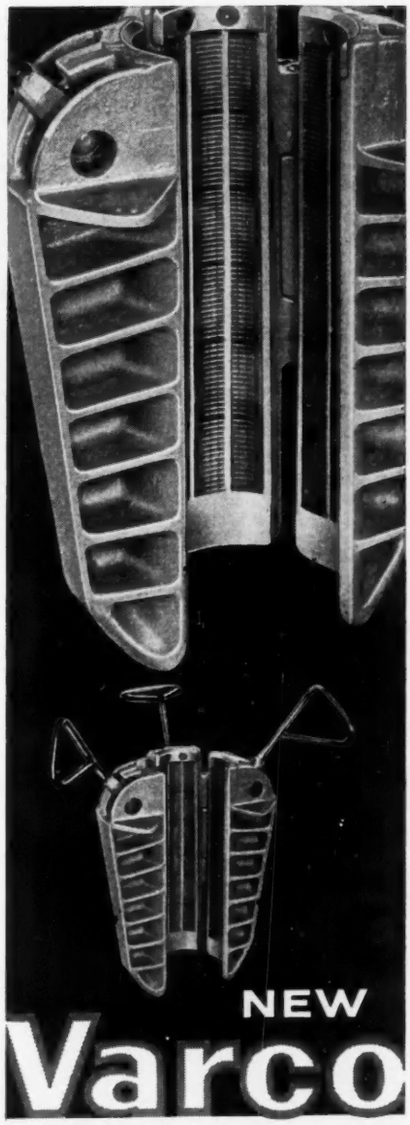
■ SUBSURFACE GEOLOGIST. Living in Europe desires responsible position. Did you discover a new oil field? I am your man to do subsurface geology, propose new well locations and develop field. Ten years successful oil experience in VENEZUELA, Colombia, Bolivia and USA as **subsurface geologist,** field geologist, micropaleontologist, well site and consultant in major and small companies. Nine years experience as practical geologist. Ph.D. I am tough and like accurate, conscientious work. Speak and write fluently Swiss German (mother tongue), high German, English, French, Spanish; some Italian. Prefer warm countries and aggressive, small or middle size company. Box BB 227-W, WORLD OIL, Box 2608, Houston, Texas, U.S.A.

INVESTMENTS

■ Financial—How Investment Banking Houses or Underwriters handle firm underwritings and private placements. For information write Box 228-W, WORLD OIL, Box 2608, Houston, Texas.

Manuscripts Wanted

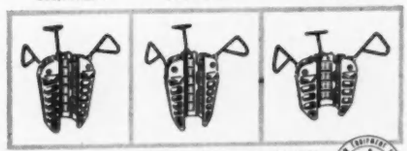
Have you written a book you would like to have published? Do you have an idea or an outline that you would like to talk over with a publisher? Gulf Publishing Company, publishers of World Oil, Petroleum Refiner and Pipe Line Industry magazines, and numerous technical books, is actively seeking trade and technical manuscripts for publication by its rapidly expanding Book Division. For further information write to Manager, Book Publishing, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas.



NEW
Varco
ROTARY SLIPS

Modern metallurgy and design make them strongest and safest
—yet they weigh no more than ordinary slips! Varco Type SDXL has 45% longer supporting back for deeper drilling. New inserts, with greater line contact, grip better; cannot be knocked out accidently. But you can replace them quickly with circular buttons for rotating drill pipe.

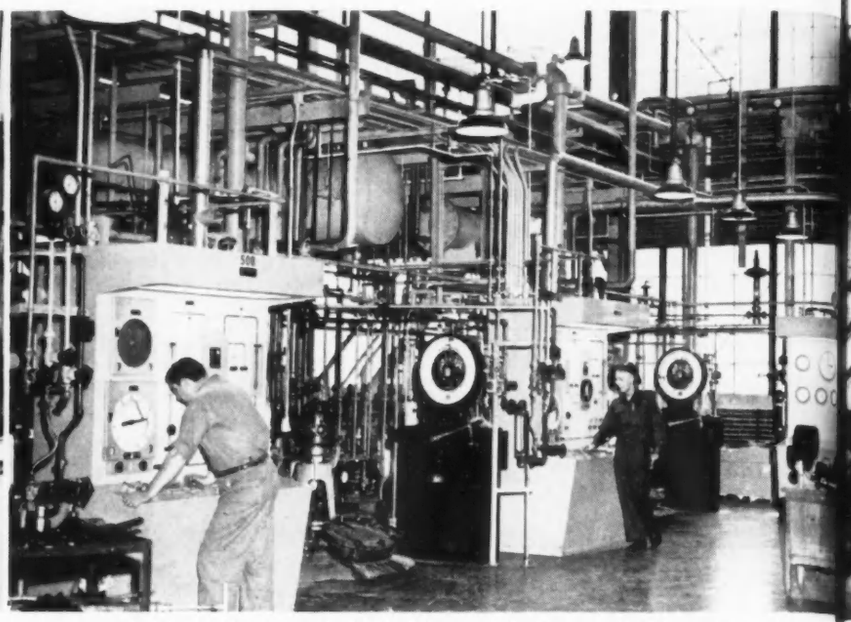
TYPE SDXL Loads over 300,000 lbs. | TYPE SDL Loads to 300,000 lbs. | TYPE SDS Loads to 180,000 lbs.



WRITE FOR LITERATURE

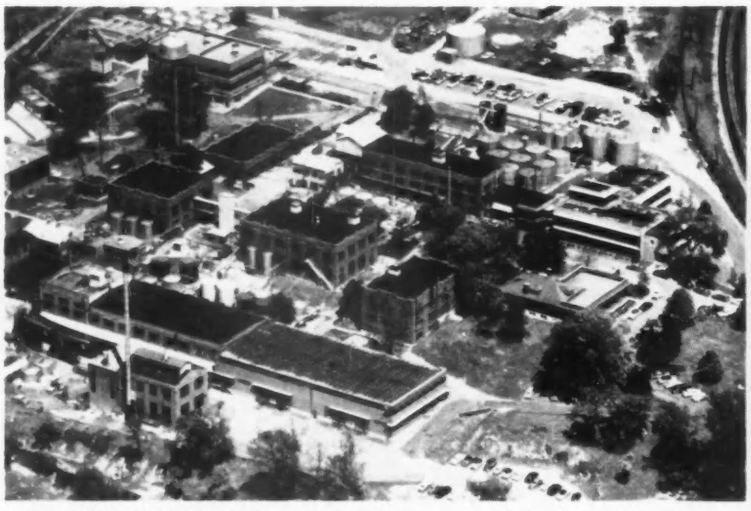
ABEGG & REINHOLD CO.
2533-41 EAST 26TH STREET
LOS ANGELES 54, CALIFORNIA
MIDCONTINENT OFFICE: HOUSTON, TEXAS

EMULSION SAMPLES are carefully tested in research laboratory at Brea, California. Tretolite technicians continuously seek new products to answer industry needs.



CONTROL CENTERS at St. Louis (illustrated), Brea, and Odessa, Texas, plants utilize latest equipment to insure uniformly high quality of Tretolite products.

RESEARCH...EXPERIENCE...



PRODUCTION FACILITIES in St. Louis include research and development headquarters with pilot laboratories. Tretolite's founder, who originated the use of chemicals to break oil-and-water emulsions, was a St. Louis chemist.

CALIFORNIA PLANT at Brea is one of network of manufacturing operations providing widespread distribution of Tretolite products.

COMPANY-OWNED WAREHOUSE at Odessa—like those in St. Louis; Brea; Houston, Texas; Great Bend, Kansas; and Liverpool, England—facilitates prompt, economical deliveries.

ALWAYS AVAILABLE for on-site testing, computations, and recommendations is Tretolite field service engineer, shown here taking line sample at ACT station.

SERVICE ENGINEERS' assistance is offered wherever oil is produced or refined. Company planes are used to reach remote and off-shore locations.

IN-FIELD TESTING by the Man in the Red Car is familiar and valuable to oilmen in Canada, Latin America, and overseas, as well as in United States.

..SERVICE...result in

DOLLARS SAVED WITH TRETOLITE

Among the "ingredients" in every drum of Tretolite products are the company's unparalleled research, experience, and service—directed toward the most effective possible treatment of petroleum at the lowest cost. Tretolite's extensive laboratory and field research, constantly seeking new and better formulas, has produced more than 600 oil-treating patents. Tretolite pioneered in this highly-specialized work almost 50 years ago, and today maintains a larger staff of field service engineers than any other supplier of petroleum demulsifiers, corrosion inhibitors, paraffin removers, and other additives and preventives. For help in saving dollars wherever you treat crude, ask the Man in the Red Car.

MODERN MANUFACTURING facilities and laboratories near Liverpool, England, and Petrolite Limited's engineering staff in London produce Tretolite chemicals for the Eastern Hemisphere.

PETROLITE CORPORATION

SUBSIDIARY AND AFFILIATED COMPANIES

CANADA, Edmonton, Alberta • **ENGLAND**, London
GERMANY, Frankfurt, a. M. • **VENEZUELA**, Caracas

TRETOLITE COMPANY
DIVISIONS
369 Marshall Avenue, Saint Louis 19, Missouri
200 South Puente Street, Brea, California

REPRESENTATIVES

ARGENTINA, Buenos Aires • **BRAZIL**, Rio de Janeiro • **COLOMBIA**, Bogota
ITALY, Rome • **JAPAN**, Tokyo • **KUWAIT**, Kuwait • **MEXICO**, Mexico, D. F.
NETHERLANDS, The Hague • **TRINIDAD**, Port of Spain

TP-61-2

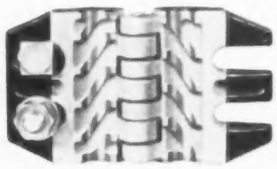
FOR DEPENDABLE COST-SAVING PERFORMANCE!

CRALL

PLASTIC COATED SCRAPERED RODS

- Automation Applied
- Multi-Coated
- Multi-Baked

CRALL Spiral Plastic Coated Scrapered Rods prevent paraffin accumulation in pumping wells saving you down-time and work-over costs. CRALL quality control manufacturing and Automation Plastic Multi-Coat, Multi-Baked processes consistently assure you of the finest most effective paraffin scraper available.



Series 280—2 Bolt

CRALL PARAMOUNT "Spiral-Grip" POLISHED ROD CLAMPS

Series 180
1 Bolt

The offset-spaced "Spiral-Grip" contact areas of CRALL-PARAMOUNT Polished Rod Clamps completely encircle the polished rod and are proven to have outstanding gripping qualities. Made of high tensile, heat-treated, patented ductile iron, pioneered by CRALL, for utmost strength that does not fail under suddenly applied loads or temperature changes. Ask about our Rod Hangers, Sub Elevators and other related products.

QUALITY CRALL OIL FIELD PRODUCTS

SOLD THROUGH YOUR FAVORITE SUPPLY STORE

CRALL PRODUCTS, INC.

P. O. BOX 1640 • PAMPA, TEXAS

Sales Offices & Plants in Principal Oil Centers

Dallas • Odessa • Midland • Wichita Falls • Tulsa
Oklahoma City • Russell • Wichita • Shreveport
Farmington • Denver • Mt. Vernon, Ill • Casper
Edmonton • Calgary • Regina

SQUEAKS

From the Bull Wheel

Modern Times

The new jet age can be defined as "breakfast in London, lunch in New York, dinner in San Francisco and baggage in Buenos Aires."

From Eggs to Odds

Did you hear about the chickens that ate the racing form and now they're laying odds?

Pays to Be Ignorant

Wife: "You look tired, dear. Did you have a bad day at the office?"

Husband: "I'll say I did. I took an aptitude test, and believe me, it's a good thing I own the company."

It Figures

Sign on a store which went bankrupt after two weeks business: "Opened by mistake."

Hold That Line

Watching an inebriated man try without success, to unlock the door to his house, a policeman asked if he could handle the key for him.

"No, thanks," the drunk replied, "I can hold the key—you hold the house."

Nice Team

The teacher asked the class to list, in their opinions, the nine greatest living Americans. After awhile she stopped at one desk and asked, "Have you finished your list yet, Bobby?"

"Not yet," he replied with a worried look. "I can't decide on the shortstop."

Oh Sweet Success

Don't blame a successful man for bragging a bit. When you catch a good string of fish, you don't go home by the back alley, do you?

Who Said That?

"How do you know you are Napoleon? the hospital attendant asked. "God told me," the patient replied.

Said a voice in the next bed, "I did not."

It Will Be a Surprise

Three pregnant cats met in an alley. The first one said, "I'm going to have a fine batch of Angora kittens."

The second said, "I'm expecting a beautiful batch of Persian kittens."

The third said, "I'm going to have some, too, but I don't know what kind they'll be. I had my head in a tuna fish can at the time."

WORLD OIL

"All this is proven high-pressure territory."

Pat It Gently

One nice thing about the foreign cars: If you flood the carburetor you can just put the car over your shoulder and burp it.

So That's Efficiency

"My husband is efficiency expert for an engineering firm."

"What does an efficiency expert do?"

"If we women did it, it'd be called nagging."

Oh Bitter Diet

"I simply can't stand my husband's nasty disposition," wept the young bride. "Why, he's made me so jittery that I'm losing weight."

"Then why don't you leave him?" asked her aunt.

"Oh, I'm going to," the bride smiled through her tears. "I'm just waiting until I get down to 120 pounds."

SECONDARY RECOVERY

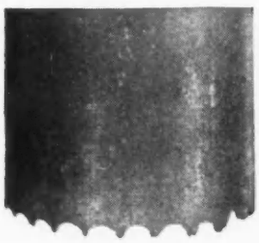
PETROLEUM ENGINEERS
STEPHENS ENGINEERING
WICHITA FALLS, TEXAS

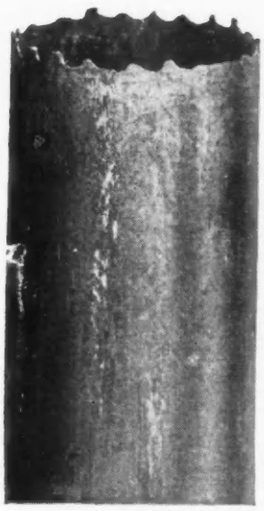
RESERVOIR ENGINEERING
Water Flooding Gas Repressuring
EVALUATION CORE ANALYSIS
SURVEYS ECONOMICS
Cost Estimates, Design, Installation
FIELD SUPERVISION
Phone 723-2167

Lower a McCullough Chemical Tubing Cutter to the desired depth. Push a button. Before you can snap your fingers, your tubing is cut.

This electric wire line tool applies the enormous power of halogen fluorides to cut tubing as easily as a knife cuts through hot butter – and it's a smooth, flare-free cut – no burrs nor distortions on either the OD or ID of the tubing.

Cutting action is closely controlled. The outside casing

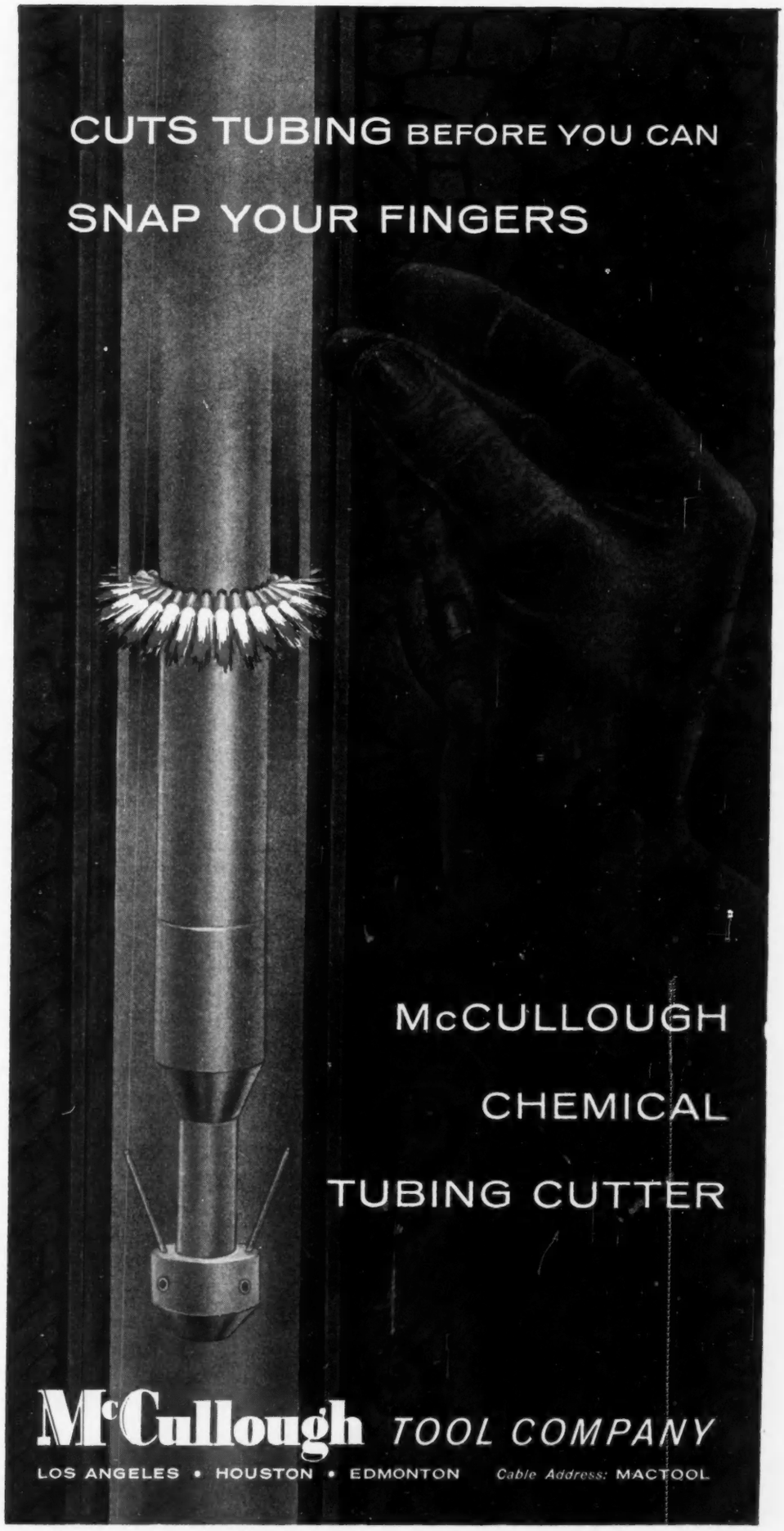




or tubing will not be damaged. Entire operation is 100% junk-free, as no part of the cutter is expendable.

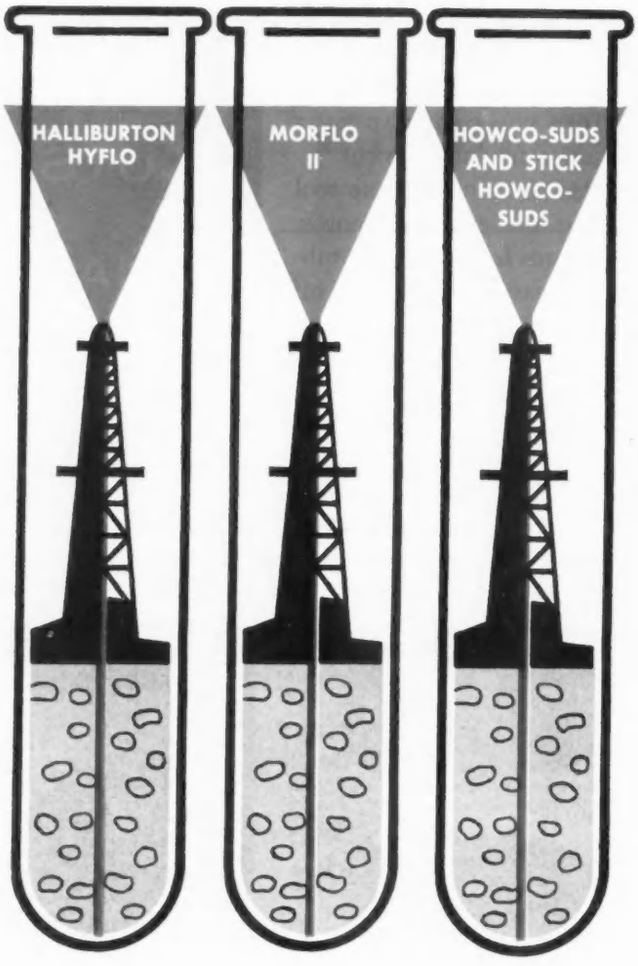
Compared to mechanical methods, you will make significant savings in valuable rigtime when you use the McCullough Chemical Tubing Cutter. Available for 2" and 2½" tubing at all McCullough Service locations.

Additional Service Representative: Houston Oil Field Material Company, Inc.



HALLIBURTON
makes it possible to

BE SPECIFIC WHEN USING SURFACTANTS



Halliburton is continually improving blends of surface active agents to perform *specific* tasks in remedial work. Since conditions vary from well to well, undesirable effects from over treating may occur unless the proper blend of surfactants is used.

The following Halliburton Surfactants are blended to combine the most desirable properties for lowering interfacial and surface tensions of formation fluids to help:

- Diffuse blocking mud particles.
- Break existing emulsions and water blocks while preventing new ones from forming.
- Revive drowned gas wells.

Halliburton Hyflo – This special blend of surfactants used with refined or crude oil serves as an *excellent emulsion breaker.* Halliburton Hyflo reduces interfacial tension between crude oil and water to a point approaching zero . . . and water wets both sand and limestone surfaces to aid production. Results from thousands of Halliburton treatments have proved the efficiency of this surfactant . . . and it gives an economical treatment under a great variety of conditions.

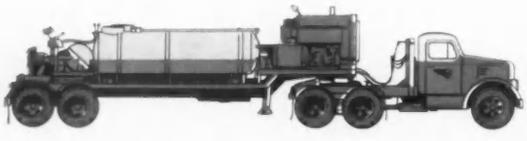
Morflo II – This blend of surfactants in HCl serves as a *mud cleanout agent.* Morflo II dispersed in water aids in breaking and preventing emulsion blocks.

Howco-Suds and Stick Howco-Suds – a water-soluble detergent blend which lowers surface tension and produces a large volume of foam to lighten hydrostatic head and aid recovery of fluid from gas wells. It is especially valuable in speeding recovery of treating fluids after acidizing or fracturing. Howco-Suds acts in fresh water or brines. Stick Howco-Suds is a weighted solid detergent cylindrical in shape which is dropped through the tubing and into the water column. The action of this convenient to use product is the same once it reaches the fluid column. The weighting material in the stick is completely soluble and enhances the foaming action.

Halliburton has met the need for selecting correct surfactant for the most *effective treatment* of nearly all wells . . . call your Halliburton representative for detailed information about using surfactants for treatment of your wells!

275 Service Centers . . .

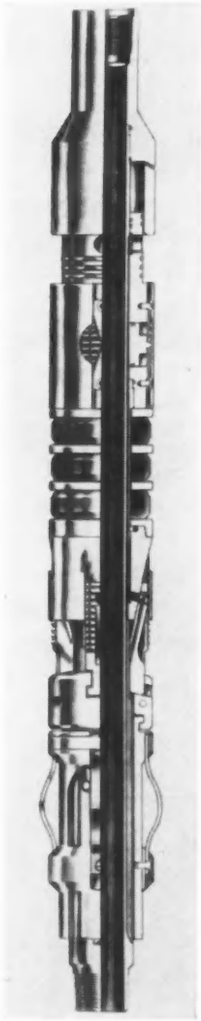
just minutes away from your well!



CHEMICAL SERVICES

Halliburton
COMPANY · DUNCAN, OKLAHOMA

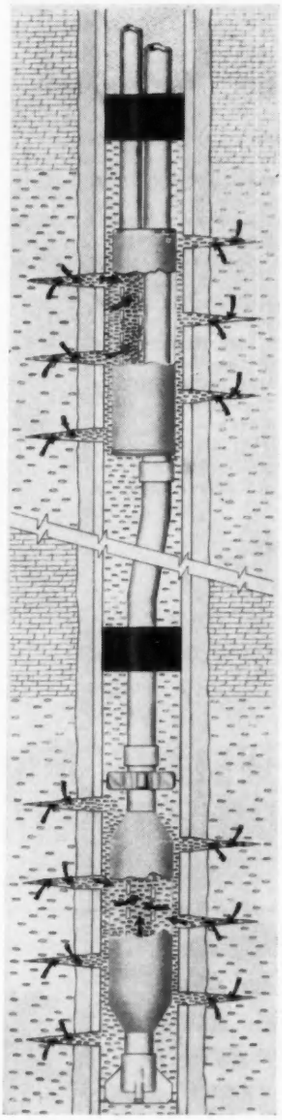
NEW equipment and services



Retrievable Production Packer

Type RSMA retrievable hook wall packer designed for production and well treatment operations. Bypass opening runs from below lower slips, behind seal elements and upper hold down buttons. Bypass is completely separated, sealed from tubing annular space and provides following features: Unloader for packer is located above hold down to aid in unloading process even if tubing is plugged; hold down buttons are sealed away from tubing bore, reducing possibility of sticking in outward position due to cement, sand, etc.; prevents dulling of hold down buttons due to dragging casing wall while running in; permits casing pressure only to set upper hold down buttons. Packer is set by normal set-down weight and one-third rotation of tubing at packer. Releasing is automatic when tubing is picked up. Available in 4½, 5½, and 7-inch sizes. (Otis Engineering Corp. Supplements data on pages 4269-4364, 1960-1961 Composite Catalog).

For more data, circle E1 on postcard



Dual Sand Screen

Dual completion sand screen controls sand intrusion from upper producing intervals. Both upper and lower screen sections consist of an outer layer of consolidated sand (compressive strengths 3,000-5,000 psi, shear strength 1,000+ psi, tensile strength 800+ psi) held in place around a mandrel of slotted tubing. Dual tubing string arrangement provides positive segregation of production. Advantages: sand, which is inert, a natural buffer and completely compatible with produced fluids is the screening medium; lower cost. Screen sections are available in 6-foot lengths. (Halliburton Co. Supplements data on pages 2301-2424, 1960-1961 Composite Catalog).

For more data, circle E3 on postcard

BOP Equipment

Light, hand portable fast shut-off coupling with valve designed for use while tripping tubing. If well should blow out through tubing during workover, coupling and valve are dropped over end of topmost joint. Coupling automatically latches and seals, and flow can be controlled with valve. (Regan Forge & Engineering Co. Supplements data on pages 4677-4696, 1960-1961 Composite Catalog).

For more data, circle E2 on postcard

COUPLINGS

LINE PIPE COUPLINGS A. P. I.
⅛" to 16"—Seamless, Black or Galvanized
PLAIN TUBING COUPLINGS A. P. I.
1" to 4"—Seamless
EXTERNAL UPSET TUBING COUPLINGS A. P. I.
¾" to 4"—Seamless
CASING COUPLINGS A. P. I.
4½" to 13⅜"—Long or Short
HYDRAULIC COUPLINGS
⅛" to 4"—Seamless
REAMED AND DRIFTED A. P. I.
1" to 12"—Seamless
DRIVE PIPE COUPLINGS
6" to 12"—Seamless
PIPE NIPPLES
All Sizes and Types
STEEL BUSHINGS AND PLUGS
Merchant and High Pressure

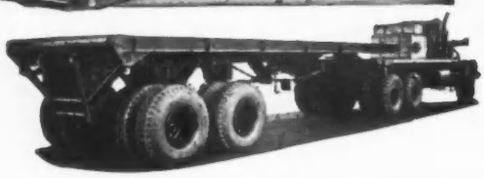
Your Order Is SHIPPED SAME DAY We Receive It

WHEELING MACHINE PRODUCTS CO. Wheeling, West Virginia
West Coast Factory: Woodlake, California

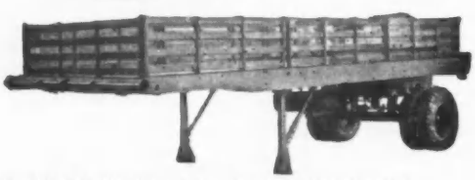
oilfield transporting equipment

OILFIELD TRUCK AND FLOAT
Thornycroft Sandmaster 252" wheel base Oilfield Truck. Hands-England full Oilfield Body. 60,000 lb. winch, heavy duty gin poles, winch operated gin pole risers and folding SAE king pin.
Hands-England 75,000 lb. capacity, tandem axle Oilfield Float 30'0" long and 9'6" wide, folding support legs and inverted 36" fifth wheel.
Truck and Float on Michelin 18.00 x 25. Sahara "X" sand tires.

OILFIELD FLOAT
Hands-England 75,000 lb. capacity tandem axle Oilfield Float 30'0" long and 8'6" wide, folding support legs and inverted 36" fifth wheel.
Float on 11.00 x 20—14-ply tires.



OILFIELD TRUCK AND FLOAT
Scammel Constructor 261" wheel base Oilfield Truck
Hands-England 75,000 lb. capacity tandem axle Oilfield Float 30'0" long and 9'6" wide folding support legs and inverted 36" fifth wheel.
Truck and Float on 14.00 x 20—18-ply tires.



OILFIELD FLOAT
Hands-England 25,000 lb. capacity single axle Oilfield Float 24'0" long and 8'0" wide, folding support legs and SAE king pin 11.00 x 20—12-ply tires. Steel stake sides.

SUPPLIED BY

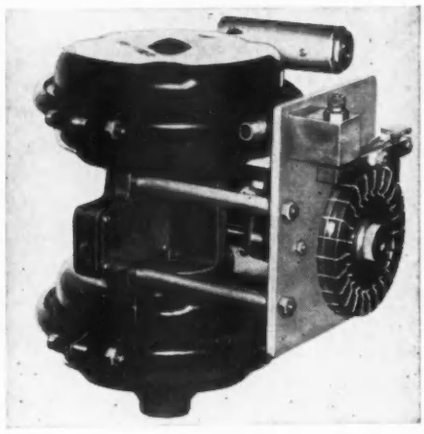
HANDS-ENGLAND OILFIELD EQUIPMENT LTD.
Works Road, Letchworth, Herts., England
Telephone: Letchworth 600 Telegrams: Oil, Letchworth Cables: Oil, Letchworth, England

New equipment

Check Valve

Clapper hingepin pivots clapper out of stream for full pressure, unobstructed passage. Other advantages: non-lubricated; operates in vertical or horizontal position; double O-rings protect threads; minimum wear. Available 2, 2½, 3, 4 and 6-inch sizes with screwed, flanged, Victaulic connections. (Frank Wheatley Pump & Valve Mfg. Supplements data on pages 5617-5636, 1960-1961 Composite Catalog).

For more data, circle E4 on postcard



Gas-Powered Intermitter

Type B Hydro-Timer uses gas pressure (5 psi minimum) to drive timing wheel through a sealed power system. Clogged orifices, clock winding, etc. are eliminated. Ideal for unattended, remote service on gas lift, stop-cocking or lease automation systems. (Otis Engineering Corp. Supplements data on pages 4269-4364, 1960-1961 Composite Catalog).

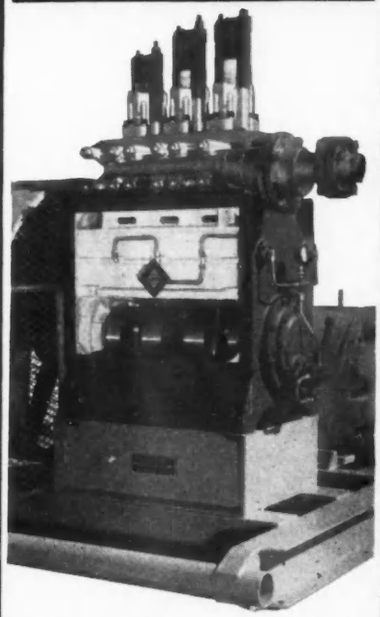
For more data, circle E5 on postcard

CALL

MID-CONTINENT

FOR

INJECTION PUMPS



SURE SERVICE — SURE SUPPLY

MC11-1

MID-CONTINENT SUPPLY CO.

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

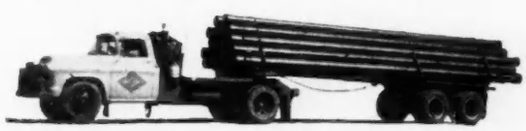
Mid-Continent Building, Fort Worth, Texas
Export Division: 45 Rockefeller Plaza, New York 20, N.Y. Cable: MIDCUMPORT NYK

Congrats and $25 for this quip to C. E. Curtis, Dailey Oil Tools, P. O. Box 1432, OCS, Lafayette, Louisiana.

Lone Star, the nation's most modern steel plant, is still growing . . still adding new facilities . . augmenting capacity . . keeping quality always at an exacting API high.

These are the reasons Lone Star is Joe Roughneck's solid source of supply for API casing, tubing and line pipe.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.



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Lone Star STEEL COMPANY

EXECUTIVE—SALES OFFICES
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DISTRICT SALES OFFICES
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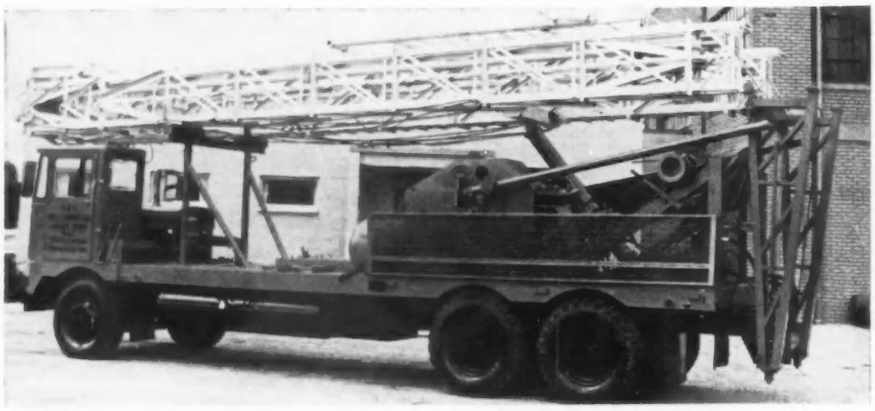
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

For more data on advertised products, use cards, last page.



Servicing Rig

Cooper TC-32 servicing unit with hydraulic singles derrick is designed for well service work to 6,000 feet with 2⅞-inch tubing. Drive system uses all gear power transfer, spiral bevel gears, torque tube drive lines. Chain used only on slow speed final drive at drum. Unit has gross weight of 37,000 pounds and measures 35 feet long by 8 feet wide by 12½ feet high in traveling position. (Fred E. Cooper, Inc. Supplements data on Pages 1491-1510, 1960-61 Composite Catalog).

For more data, circle E6 on postcard

KEN-PAK DOES IT AGAIN!...

Longest String of Protection Casing Recovered In Gulf Coast!

ken-pak

"Mon! Ye'll save steel when ye ken aboot KEN!"

Read This Field Report:

"9⅝", 47 lb/ft casing cemented at 8,442′ on June 17, 1961. Top of cement estimated at 7,700′, with Ken-Pak from top of cement to shoe of surface pipe at 2,000′. Hole drilled to 14,766′ and proved to be dry. Casing pulled August 10, 1961. Free-point at 7,516′. Casing collar locator gave trouble so shot pipe at 7,438′. Pulled 7,438′ of 9⅝", 47 lb/ft casing, valued at $27,190. Ken-Pak and total rig time cost $4,752. Net savings $22,437. Operators very pleased, will use Ken-Pak again soon. Recovered casing already used in another well. Believed to be longest protection string ever recovered on Texas Gulf Coast."

Proved in hundreds of wells around the world, Ken-Pak is an oil base gel that packs around casing, protects against corrosion better than cement and permits maximum casing recovery. Save money—use Ken-Pak.

Contact your nearest Ken distributor, or

KEN CORPORATION
2499 Cerritos Ave., Long Beach 6, California
Phone: GA. 644-28

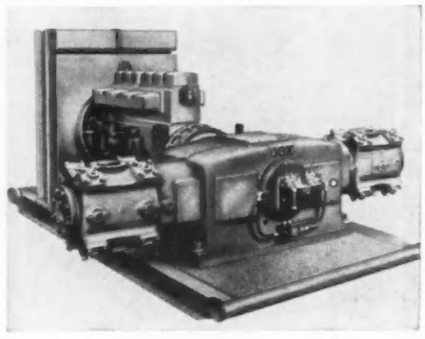
ken CORPORATION

WORLD'S LEADER IN OIL BASE MUDS

Low-Water Loss Additive

A new low-water loss additive with superior characteristics for primary and remedial cementing is now available. This free flowing powder can be added to the dry cement or to the mixing water. Halad-9 functions are: Gives fluid loss control under high pressure test conditions (1,000 psi—325 mesh screen) superior to other fluid loss additives on a pound per pound basis. (Halliburton Company. Supplements data on Pages 2301-2424, 1960-1961 Composite Catalog).

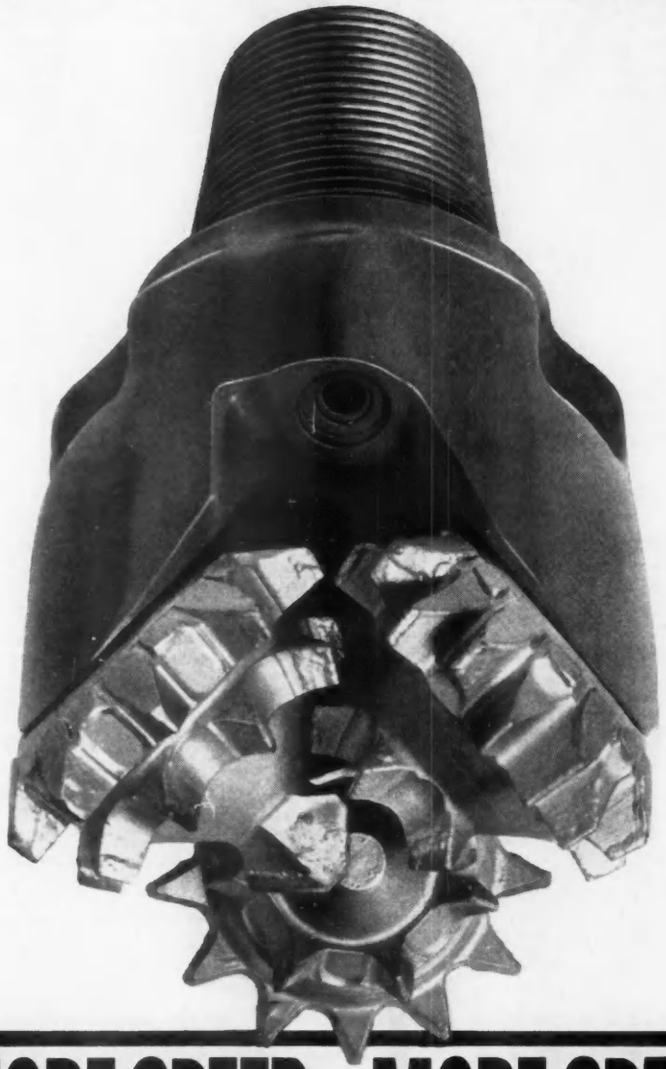
For more data, circle E7 on postcard



Packaged Compressor

Horizontal opposed Model WBF-52 field gas gathering compressor with nominal horsepower range of 200-300 BHP is compact, vibration free. Unit developed for direct connection to 1,000 rpm natural gas engines. Can be mounted on slabs, trailers, barges or piling. Completely packaged with air cooling equipment for air, water and oil, scrubbers, knock-out drums, surge chambers, pumps, traps, controls, and piping. (Joy Mfg. Co. Supplements data on pages 3093-3102, 1960-1961 Composite Catalog).

For more data, circle E8 on postcard



MORE SPEED...MORE SPACE
WORLD-WIDE SERVICE

Profitable words to remember when you're looking for speed and dependability: Air France Cargo Service. Air France cargo flights carry oil-drilling equipment to key points across the world . . . Near East, West Africa, Central Africa, Algeria, the Sahara, and more! Frequent departures throughout the week from New York, Los Angeles, Chicago, Montreal. Every flight carries 10,000 lbs.! You save on crating, shipping weight. New low insurance costs, too! Air France speeds cargo to more cities in more countries than any other airline. Specify Air France to your Cargo Agent!

AIR FRANCE CARGO

No-Wall-Stick Drill Collars Being eyed by the drilling industry

In the past year the No-Wall-Stick drill collar design has proved itself to be one of the few major improvements in drilling equipment since the introduction of the rock bit.

ENGINEERING ENTERPRISES, INCORPORATED

1200 San Jacinto Bldg.
Houston 2, Texas
CA 8-0386

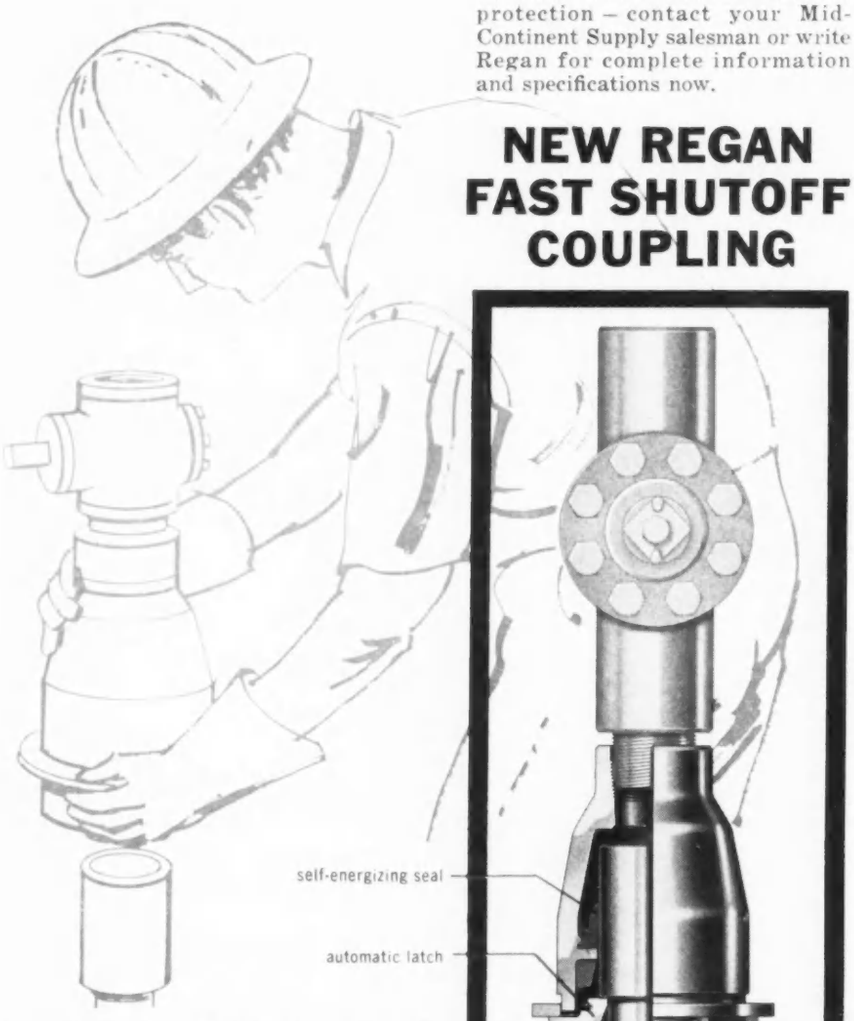
No-Wall-Stick Drill Collars are available on a rental basis or may be purchased by the operator or drilling contractor.

NWS U.S. PATENT NO.-2,999,552

Lightweight, hand-portable shutoff coupling controls blowing up the tubing quickly, safely

Now, for less than the cost of cleaning up a rig, you can quickly and effectively control the well. The Regan fast shutoff coupling, with a plug valve attached, is kept on the rig floor when running or pulling tubing. If the well starts to blow, the lightweight aluminum alloy coupling is quickly dropped over the top of the tubing string, automatically latching on and sealing off around the tubing collar. A quick turn on the valve and the well is then under control – all handled quickly and easily by one man. Get the facts on this fast new blowout protection – contact your Mid-Continent Supply salesman or write Regan for complete information and specifications now.

NEW REGAN FAST SHUTOFF COUPLING



Ruggedly constructed of aluminum alloy, the new fast shutoff coupling weighs approximately 18 lbs. and can be easily handled by one man. Its action is quick, effective and dependable.

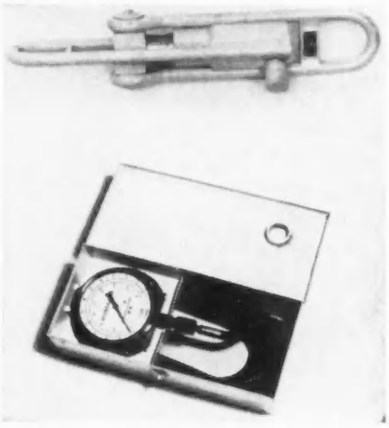
Regan® Forge & Engineering Co.

Quality – Wrought on the Forge of Experience

P. O. BOX 150 SAN PEDRO, CALIF.

Exclusive World Wide Distributors: MID-CONTINENT SUPPLY CO., FT. WORTH, TEXAS

New equipment



Hydraulic Weight Indicator

This Hydro-Cator is a hydraulic weight indicator which utilizes the piston and cylinder principle. With its high degree of accuracy, it is suited for steady reading of load setting and releasing packers, pulling and running tubing, rods or casing and for fishing operations. May be used in operations where there is a need for accurate indication of load or tension. (Oil States Rubber Company. Supplements data on Pages 4107-4110, 1960-1961 Composite Catalog).

For more data, circle E9 on postcard

Flanged End Connections

These integral flanged end connections are available on high pressure 1-inch and 2-inch angle and globe style cast steel valve bodies for oil and gas production, power plant installations and the process industries. Are available with either 1,500 or 2,500-pound ASA flanges. Maximum operating temperature is 450° F. Two-inch bodies can also be furnished with 10,000-pound API flanges, rated at 250° F. (Fisher Governor Company. Supplements data on Pages 1837-1846, 1960-1961 Composite Catalog).

For more data, circle E10 on postcard

NOW
MORE DRILLING INFORMATION

THE MODELS G7PW OR G7TW RECORDER

These models of the Geograph Recorder were developed particularly for the contractors and operators desiring more detailed, recorded data concerning the four drilling variables—Rate of Penetration, Drilling Weight, Pump Pressure and Torque. This information is required to compete in today's highly competitive drilling situation.

Geologists obtain more information about rate of penetration and sub-surface formations and toolpushers are supplied with the information necessary to determine the optimum drilling rate for a particular formation.

Engineers and contractors can readily interpret the recordings of weight on bit, pump pressure (or torque), downtime, rate of penetration, tightspots and bit wear in making accurate decisions regarding existing drilling conditions.

The result: more hole per dollar.

When you drill your next well, specify the Model G7PW or G7TW Recorder. For additional information, ask for Catalog No. 220, or call your nearby Geograph Oil Field Services office.

GEOGRAPH
OIL FIELD SERVICES®
P. O. Box 1276
Oklahoma City 1, Okla.

"FIRST" for years in OEM

Now "FIRST" in Replacements

ANCHOR

Pressed-On Hydraulic Hose Assemblies, Reusable Couplings, Hose and Fittings

Feature for feature . . . Anchor *replacement* Pressed-On Hydraulic Hose Assemblies, Reusable Couplings, Hose and Fittings are *one and the same* as the already comprehensive Anchor line . . . first and foremost with original equipment manufacturers today . . . and for over 20 years.

Anchor ALL THE WAY . . . completely factory assembled from Couplings to finished Hose Assemblies . . . *ready to use* . . . your best buy *always* is ANCHOR . . . field-proved for top quality . . . long operational life . . . peak performance.

Your nearest Anchor distributor . . . in all principal markets . . . will serve you quickly . . . whatever your needs for Anchor hydraulic component replacements.

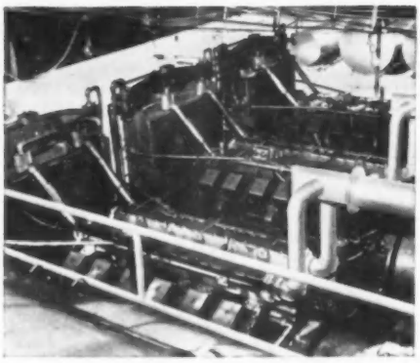
Andy Anchor says: "Ask your Anchor distributor for descriptive literature . . . full of valuable data on Anchor hydraulic hose, couplings and fittings for replacements . . . or write direct."

ANCHOR Coupling Co. Inc.

Box 111, Dept. NN, Libertyville, Ill.
Branch Plants: Dallas, Tex., Plymouth, Mich.

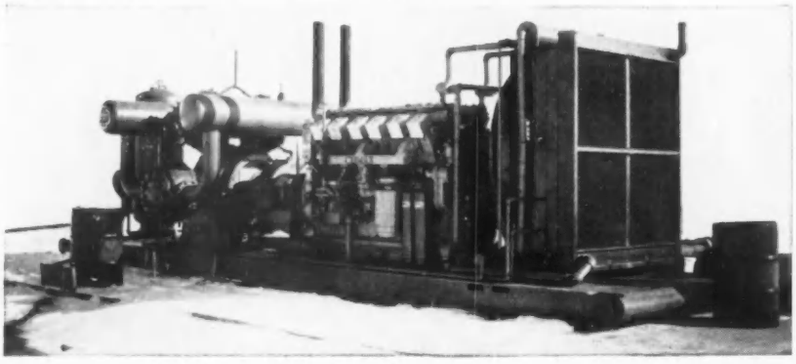
it's CLIMAX

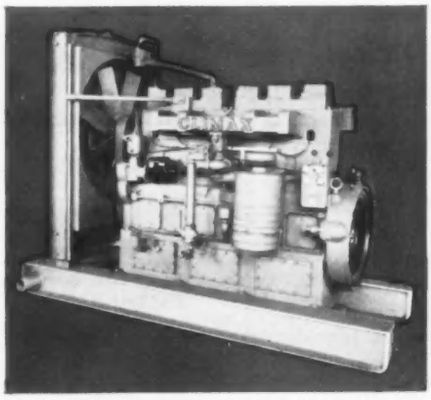
for DRILLING and PUMPING



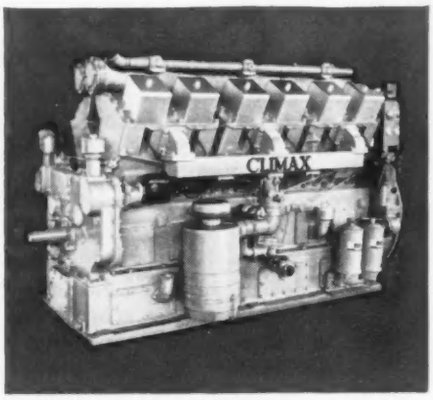
● Climax Engines have proven their reliability in hundreds of oil field installations. Single, well balanced design, rugged construction, and quality materials make them smooth running . . . for years!

for COMPRESSORS

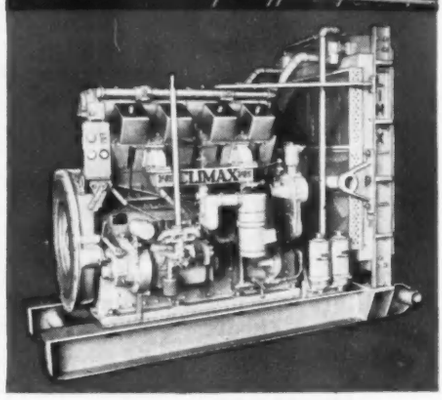




Model K-67—Max. hp 265 (Natural Gas)



Model V-125—Max. hp 605 (Natural Gas)



Model V-85—Max. hp 390 (Natural Gas)

CL-116-R

CONT. DUTY (NAT. GAS) →			DRILLING-PUMPING (80% RATINGS)						COMPRESSORS (65% RATINGS)				
Model	Bore & Stroke	Displ.	Peak Torque @ RPM	Brake hp at Speeds Indicated					Peak Torque @ RPM	Brake hp at Speeds Indicated			
				600	800	900	1000	1100		800	900	1000	1050
R-165	6⅛ x 7	1238	684 @ 750	81	105	117	127	135	557 @ 800	85	95	103	108
K-67	7 x 7	1616	955 @ 850	110	145	161	176	188	775 @ 800	118	131	143	149
K-75	7½ x 7	1855	1090 @ 800	126	166	185	204	218	885 @ 800	135	151	166	174
V-80	7 x 7	2155	1240 @ 850	140	188	210	230	246	1002 @ 800	153	171	187	194
V-85	7½ x 7	2474	1460 @ 800	164	223	246	266	284	1185 @ 800	181	200	216	222
V-122	7 x 7	3232	1920 @ 800	217	293	328	353	378	1562 @ 800	238	265	288	300
V-125	7½ x 7	3711	2240 @ 850	242	340	384	417	442	1820 @ 900	276	312	340	354

CLIMAX ENGINE MANUFACTURING CO. • DIVISION OF WAUKESHA MOTOR COMPANY

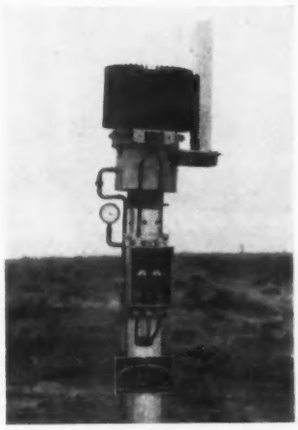
FACTORY—CLINTON, IOWA

New equipment

Helical Centralizer

Centralizer is equipped with bows made of high alloy steel and drop forged in true helix shape with concave cross section. Concave cross section provides maximum bow strength for positive centering, eliminates wall gouging and avoids torquing casing while running pipe. Helical design provides maximum agitation of displaced fluid. Centralizers are available in six models with solid or hinged collars and integral stop devices. (B&W, Inc. Supplements data on Pages 345-352, 1960-61 Composite Catalog).

For more data, Circle E11 on postcard



Thermoelectric Generator

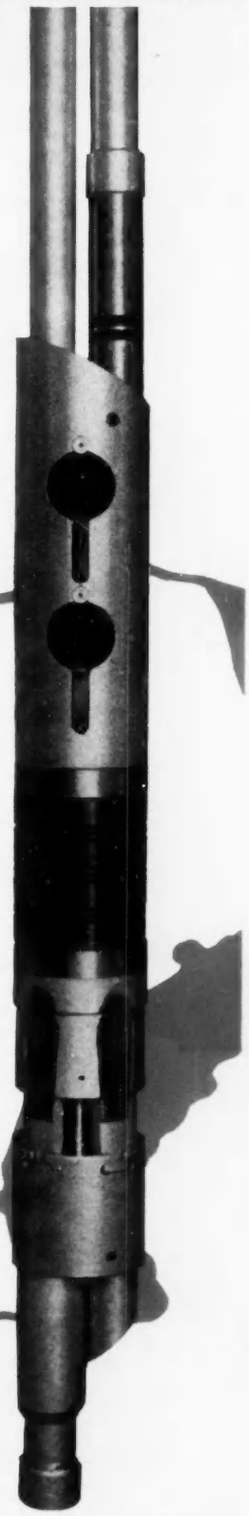
An 8-watt thermoelectric generator with no moving parts has been developed to provide electric power for remote cathodic protection installations and unattended automatic production facilities. Unit operates from natural gas, propane or butane. No housing or special enclosure is required since burner is free from wind blowout. Generator weighs 65 pounds and measures 12 inches wide by 17 inches high. (Texas Instruments Inc.).

For more data, Circle E12 on postcard

ANOTHER PRODUCT WITH PROVEN PERFORMANCE ENGINEERED BY

TIW

TYPE HDSL SNAP-LOK DUAL STRING PACKER



MOST EFFICIENT ... RUGGED ... ECONOMICAL ... PERFORMANCE PROVED DUAL STRING PACKER. CAN BE EXPECTED TO PERFORM ON FIRST RUN.

These are among the many features that make the T-I-W Type HDSL SNAP-LOK Dual String Packer first choice for dual completion efficiency: Packer can be set, released and re-set without coming out of hole by use of snap lock. Snap lock mechanisms used for positive indication when setting or tagging seal nipples. Positive acting, dove-tail slips are easily set and unset. Especially designed packoff rubbers, seat and seal easily, with minimum of weight. Setting weight on second string does not add weight to bottom packer through first string.

Get the most for your money. Let experienced T-I-W service men assist with the selection of the right equipment for your well . . . and see that you get first-run performance, with dependable T-I-W field-service installation. CALL, WRITE or WIRE for details TODAY!

Manufacturers of: T.I.W. Portable Rigs . . . T.I.W. Safety Joints . . . T.I.W. Rotary and Casing Slips . . . T.I.W. Grief Stem Safety Valves . . . T.I.W. Packers for every purpose . . . T.I.W. Pump Chambers . . . T.I.W. Mudmixers . . . and many other oil field tools.

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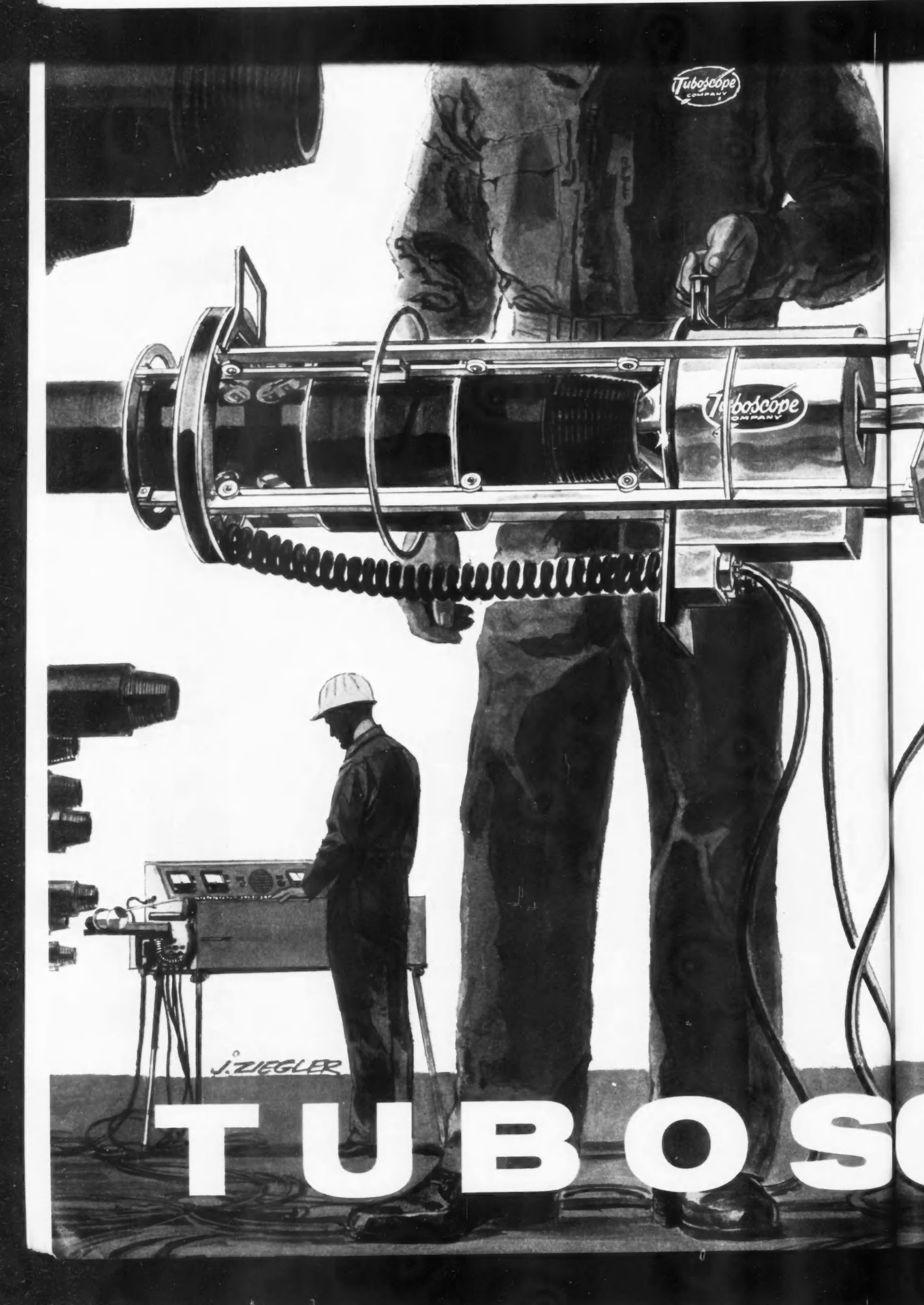
EXPORT REPRESENTATIVES: Val R. Wittich, 30 Rockefeller Plaza, New York, N.Y.
IN VENEZUELA: Oilfield Sales & Service, S. A., Anaco & Maracaibo
IN CANADA: Garrett Oil Tools, Ltd., Edmonton, Alberta

134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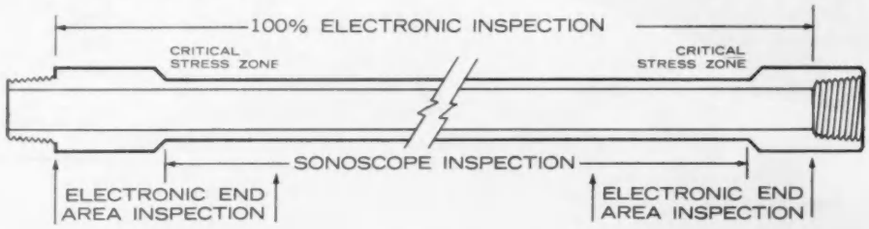
COMPANY
Tuboscope
J. ZIEGLER
TUBOS

First major advancement
in drill pipe inspection since 1957

NEW INVENTION STOPS END AREA FAILURE

NOW! Drill pipe end areas electronically inspected with new electronic end area inspection instrument

Exclusively, and for the first time in the drilling industry, Tuboscope offers electronically accurate inspection of drill pipe end areas. With electronic end area inspection and SONOSCOPE® inspection of the pipe body, your drill pipe may be inspected from end to end with unequaled accuracy.



You can select reusable drill pipe with confidence never before possible.

Many Drill Pipe Failures Occur in the End Area

Increasing demands for faster drilling mean more stress in drill pipe end areas. Now Tuboscope offers a superior method of inspecting this danger zone.

Potential Failures Eliminated From Your String

Now you can select, in complete confidence, good drill pipe for re-use and discard that which is dangerous to continue in service. Tuboscope electronic end area inspection, when used in conjunction with superior SONOSCOPE® with MINIMAX,* gives you the world's most reliable drill pipe analysis. For a demonstration of this new concept in drill pipe inspection, contact your nearest Tuboscope representative.

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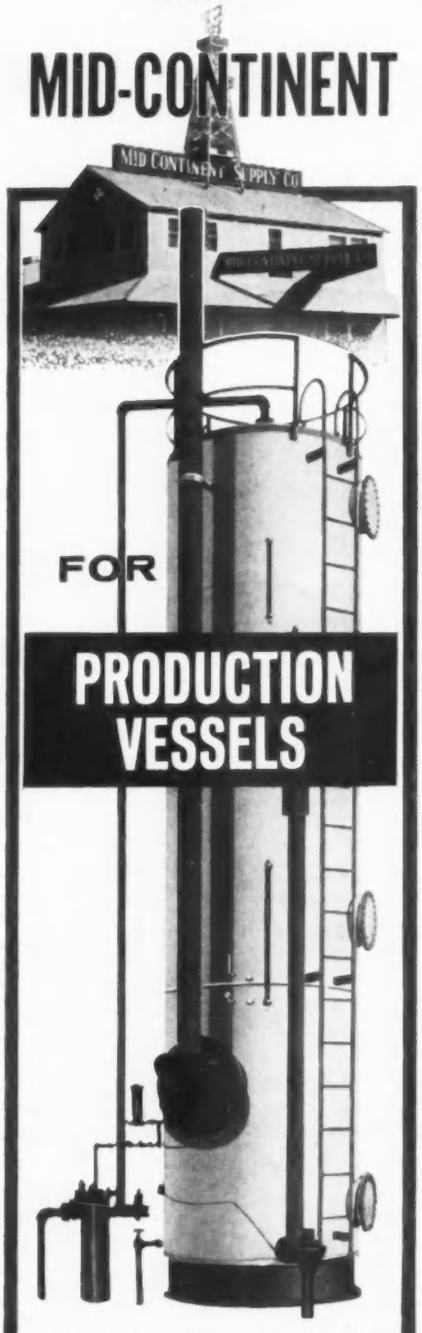
MID-CONTINENT



FOR

PRODUCTION VESSELS

SURE SERVICE — SURE SUPPLY

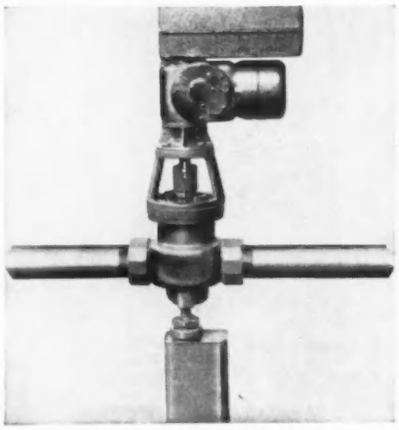
MC12-1

MID-CONTINENT SUPPLY CO.

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

Mid-Continent Building, Fort Worth, Texas
Export Division: 45 Rockefeller Plaza, New York 20, N.Y. Cable: MIDCUMPORT NYK

New equipment



New Liquid Sampler

This new sampling unit provides a simple, accurate and convenient method of collecting representative samples of liquid flowing in pipe lines. Is operated manually or automatically on any pipe line, regardless of pressure. Advantages: Nothing to drain, clean or bleed before taking sample from line; sample is taken at line pressure and stored in container at atmospheric pressure. Samples contain full cross section of fluid, eliminating error due to stratification of liquid. (Arcco Instrument Company, Inc.)

For more data, circle E13 on postcard

Tool Joints

Joints designed for small diameter well work. 2⅞-inch Type PAC joint (pictured) used for drilling and coring operations below 4½ or 5-inch liners. PAC uses open hole thread form of four threads per inch with 1½ inches of taper per foot. 1¼-inch Type MT joint designed for 1¼-inch tubing, used for service work in 2⅞-inch OD casing. Design is six threads per inch on 1½ inches taper per foot. Joint is friction welded to the tube. (American Iron & Machine Works).

For more data, circle E14 on postcard

CUT STUCK SAND LINES INSIDE TUBING

KINLEY SAND LINE CUTTER

J. C. KINLEY CO., Licensees

ABILENE, TEXAS
Eads Engineering Services, Inc. ..... OR 2-8655
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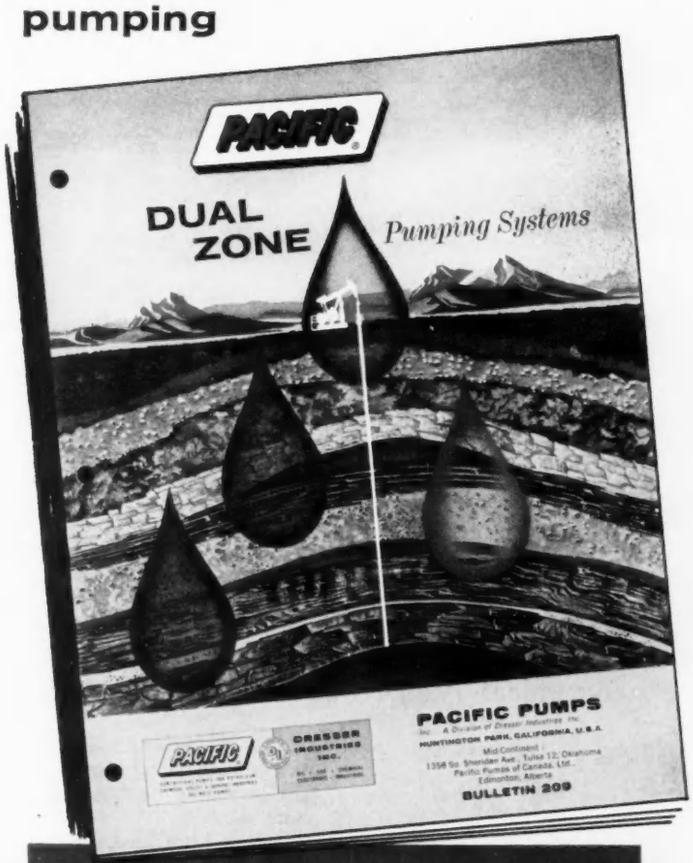

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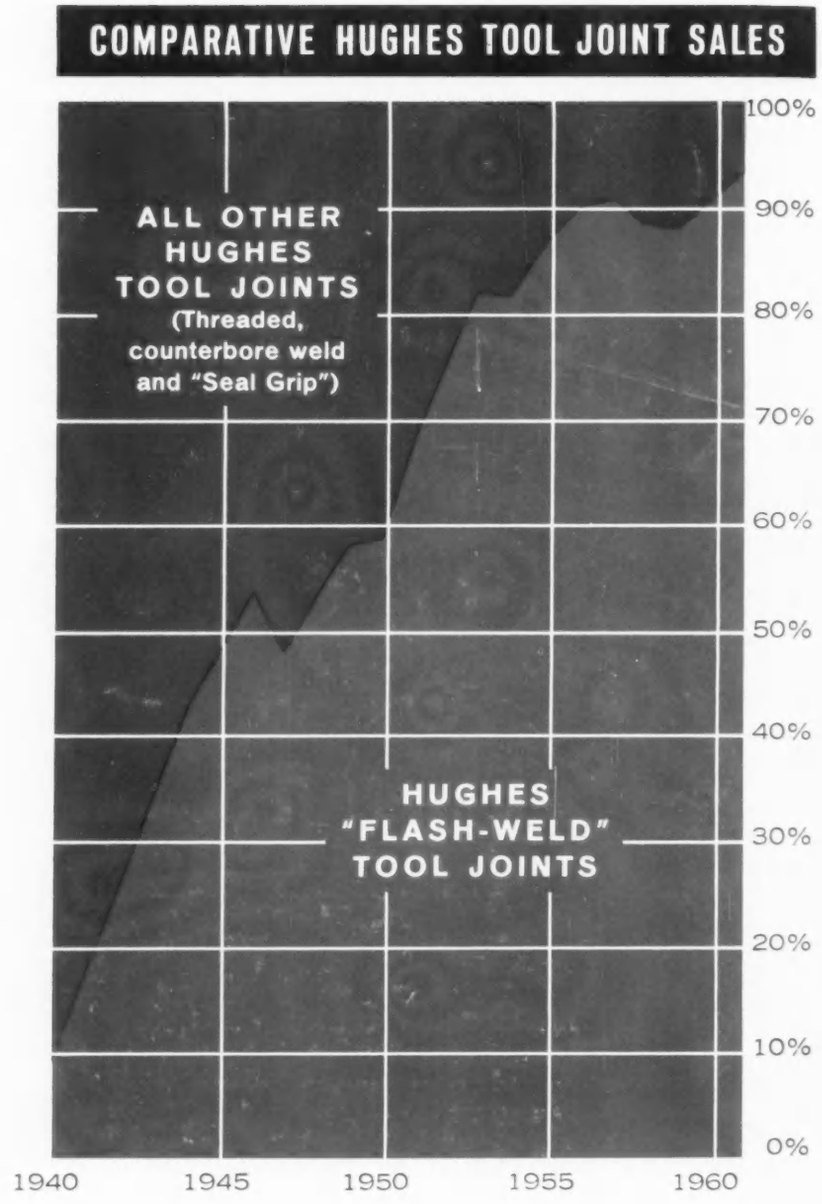

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